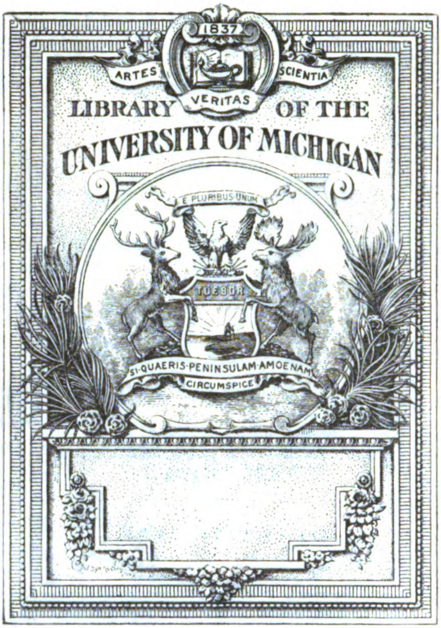
THE Year Book of Wireless Telegraphy AND TELEPHONY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Published Weekly.] ESTABLISHED 1856. [Price Sixpence.

The Engineer.

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VOL. CXV.—No. 2978] LONDON FRIDAY EVENING, JANUARY 24, 1913. [PRICE (WITH INDEX AND OTHER SUPPLEMENT) ONE SHILLING

NOTICE TO MANUFACTURERS OF METAL-PLANING MACHINES.

The Director-General, Ordnance Survey, is prepared to RECEIVE APPLICATIONS from any Firm which is willing to TENDER for the SUPPLY of a METAL-PLANING MACHINE.

Applications for forms of Tender and specification should be made to the officer in charge of stores, Ordnance Survey Office, Southampton.

All Tenders must be submitted before noon on the 31st January, 1913. 300

Assistant Engineer ReQUIRED for the Lagos Water Works by the Government of Southern Nigeria for one tour of not less than eight nor more than twelve months residential service with possible extension. Age between 25 and 40. Strict medical examination and vaccination if necessary.

Salary at the rate of £500 a year. Free single furnished quarters provided, or an allowance for rent in lieu as the Government shall consider equitable.

Free first-class passage out and home again on satisfactory termination of engagement. Half salary on voyage out, full salary from date of arrival in the Colony.

Five days leave on half pay in respect of each completed month of residential service with half pay during voyage or voyages and free passages.

Candidates should possess the following qualifications:—

(a) Must belong to Institution of Civil Engineers.
(b) A knowledge of machinery, a year's training in shop is efficient.
(c) Experience in laying of mains from 3in. to 28in., also the laying out of pipe trenches, fixing of valves, hydrants, &c.
(d) A general knowledge of waterworks construction.
(e) Thoroughly efficient in the use of theodolite and level.
(f) Able to make returns of the cost of work.

Applications by letter (no special form required), stating age, giving full particulars of experience accompanied by copies of testimonials (not originals), with names and addresses of referees of whom enquiries can be made as to capabilities and character should be sent at once to the Crown Agents for the Colonies, Whitehall-gardens, London, S.W.

Quote M/5702 on left-hand top corner of application. 336

India Office, Whitehall,
London, S.W., 23rd January, 1913.

By Order of the Secretary OF STATE FOR INDIA IN COUNCIL. APPOINTMENT of ASSISTANT CHEMIST and ASSISTANT LABORATORY OFFICER for work at Calcutta.

The salary of the appointments is Rupees 450, rising by annual increments of Rupees 50 to Rupees 600 per mensem, and not as stated in the advertisement which appeared in the issue of the 17th instant.

H. J. W. FRY,
Director-General of Stores.
360

Royal Institution of Great BRITAIN,
Albemarle-street, Piccadilly, W.

THURSDAY next (January 30), at Three o'clock, Professor B. HOPKINSON, M.A., F.R.S., FIRST of TWO LECTURES on "Recent Research on the Gas Engine." Half a Guinea the Course. Subscription to all the Courses in the Season, Two Guineas. 313

PATENTS AND DESIGNS ACT, 1907.

Notice is Hereby Given that ALLEN RANSOME, of Stanley Works, Newark-on-Trent, Engineer, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 7150 of 1905, granted to him for "Improvements in BAND SAWING MACHINERY."

Particulars of the proposed amendment were set forth in the "Illustrated Official Journal (Patents)," issued on the 22nd January, 1913.

Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 18 at the Patent Office, 25, Southampton-buildings, London, W.C., within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.

Carpmael and Co.,
24, Southampton-buildings,
London, W.C.
Agents for the Applicant. 368

Bengal-Nagpur Railway ComPANY, LTD.

The Board of Directors are prepared to receive TENDERS for:—

8 WHEEL COUPLED GOODS ENGINES & TENDERS, 5ft. 6in. gauge.
8 WHEEL COUPLED GOODS ENGINES & TENDERS, 2ft. 6in. gauge.

Specifications and forms of Tender can be obtained at the Company's offices, 132, Gresham House, Old Broad-street, London, E.C., on or after 22nd January, 1913.

For each specification a fee of £5 5s. will be charged, which will not be returned.

Tenders to be submitted not later than noon on Thursday, 6th February, 1913.

The Directors do not bind themselves to accept the lowest or any Tender.

By order of the Board,
JOHN MANSON,
Managing Director.
380

Bombay, Baroda and Central INDIA RAILWAY.

The Directors are prepared to receive up to noon on Tuesday, 4th February, TENDERS for the SUPPLY of—
CAST IRON POT SLEEPERS and
RAILS and FISHPLATES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Acting Secretary.

Offices: Gloucester House,
132, Bishopsgate,
London, E.C.,
23rd January, 1913. 370

County of London.—London COUNTY COUNCIL TRAMWAYS.
SPECIAL SECTION MILD STEEL BARS FOR MAGNETIC BRAKE SHOES.

The London County Council invites TENDERS for the

Bombay Municipalty.—SupplyING AND LAYING 54in. DIAMETER STEEL MAIN.

The DATE for the RECEPTION of these TENDERS has been POSTPONED until the 25th March, 1913.

Intending contractors will be able to obtain further particulars as to transport and other matters on application to us on and after Monday the 3rd day of February.

By order of the Municipal Commissioner,
JOHN TAYLOR, SONS and SANTO CRIMP.

Caxton House,
Westminster, S.W. 335

City of Sheffield.—Steel Tram RAILS.

The Corporation of Sheffield are prepared to receive TENDERS for the SUPPLY of 1000 Tons of STEEL TRAM RAILS.

Specification and drawings, with form of Tender and conditions of contract, can be obtained on application to Mr. W. J. Hadfield, Surveyor of Highways, Town Hall, Sheffield, and sealed Tenders (enclosed in the official envelope provided) must be lodged at his office not later than 10 a.m. on Saturday, February 8th, 1913.

A deposit of £2 2s. is required, which will be refunded on the return of the specification, &c., together with a bona fide Tender.

The Corporation do not bind themselves to accept the lowest or any Tender, nor will they defray any expenses in relation thereto.

Any person or firm sending in a Tender will be required to add a schedule to such Tender stating the names of the various classes of labour which he or they intends or intend to employ, together with the places where such labour will be employed, and the rate of wages, hours of labour, and conditions of employment to be paid and observed in respect to each class of labour, all of which, as shown in such schedule, shall comply with the City Council's form of clauses respecting wages, hours, and conditions of labour, and prohibition against assigning or subletting, contained in the conditions of contract above referred to.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Sheffield,
January 10th, 1913. 307

Egyptian Government.— MINISTRY OF PUBLIC WORKS.
PORT SAID DRAINAGE.
CONTRACT No. 1.

The Ministry of Public Works, on behalf of the Municipality of Port Said, invites TENDERS for the CARRYING OUT of the following WORKS either for the whole or parts (a) and (b) separately:—

(a) SEWER RETICULATION, Comprising Sewers, Manholes, Flushing Tanks, Street Gullies, and other appurtenant works, and

(b) COMPRESSED AIR SYSTEM, comprising Ejectors, Sealed Sewage Mains, Air Mains, and other appurtenant works.

Tenders must be received not later than noon on March 1st, 1913.

Copies of the "Conditions of Tender" may be obtained free of charge on application to:—

1. The Office of the Controller General, Main Drainage Department, Ministry of Public Works, Cairo.
2. A. L. Webb, Esq., C.M.G., Queen Anne's Chambers, Broadway, Westminster, London, S.W.
3. The Commercial Intelligence Branch of the Board of Trade, London, where can also be seen copies of the detailed description of work, together with plans, drawings, and other relevant documents.

Copies of the detailed description of work, together with plans, drawings, and other relevant documents with respect thereto, can be obtained on payment of the sum of £5 (£5 2s. 7d.) from:—

1. The Office of the Controller General, Main Drainage Department, Ministry of Public Works, Cairo.
2. A. L. Webb, Esq., C.M.G., Queen Anne's Chambers, Broadway, Westminster, London, S.W.

The Municipality of Port Said does not bind itself to accept the lowest or any Tender.

C. CARKEET JAMES, M. Inst. C.E.,
Controller General.

Main Drainage Department,
Ministry of Public Works,
Cairo, Egypt. 916

Essex and Colchester Asylums. ELECTRICALLY-DRIVEN AIR-COMPRESSOR PLANT.

The Committee of Visitors of the Essex and Colchester Lunatic Asylums invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of the following PLANT and WORKS for Severalls Asylum, Colchester:—

CONTRACT No. 7.—DUPLICATE MOTOR-DRIVEN AIR-COMPRESSOR PLANT complete with Pipework, Cables, Switchgear, and all Accessories, utilising one compressor already on site.

Plans and specifications can be seen, but not obtained, at the offices of Mr. W. C. C. Hawtayne, Consulting Engineer, 9, Queen-street-place, London, E.C.

A copy of the specifications, with forms of Tender, general conditions, and plans, will be forwarded on application being made to the undersigned, accompanied by a deposit of £1 2s. on or before the 1st February, 1913. The deposit will be returned on receipt of a bona fide Tender, and on return of the specifications and plans complete.

The contractor must, at his own expense, give sufficient security to the satisfaction of the Committee.

Tenders, sealed and marked "Tender for Compressor Plant," to be addressed to the undersigned and delivered at or before noon on the 10th February, 1913.

The Committee do not bind themselves to accept the lowest or any Tender.

H. H. GEPP,
Clerk to the Visiting Committee.

57, New-street, Chelmsford.
15th January, 1913. 286

George Town Municipality, PENANG.
AYER ETAM RESERVOIR.
PORTLAND CEMENT.

The Municipal Commissioners of George Town, REQUIRE 500 Tons of PORTLAND CEMENT, to Official and British Standard Specifications, for Ayer Etam Service Reservoir Works, delivered at Contractor's risk at George Town, Penang, Straits Settlements, between 30th April and 31st August, 1913.

Tenders, from manufacturers only, marked "Penang Cement," should be lodged on or before 3rd proximo with the Commissioners' Home Agent, C. C. LINDSAY, Esq., M. Inst. C.E., 180, Hope-street, Glasgow, who will supply the Official Specification to Manufacturers.

The Commissioners' Agent does not bind himself to accept the lowest or any Tender. 253

Hampton Urban District COUNCIL.
AIR-COMPRESSING MACHINERY.

The above Council are prepared to receive TENDERS for the SUPPLY and ERECTION at their Sewage Disposal Works of a DUPLICATE SET of CONDENSING STEAM ENGINE AIR COMPRESSORS and other subsidiary works in connection therewith.

Plan, general conditions, specification, form of Tender, and other particulars, may be obtained of the undersigned at the Offices of the Council, where Tenders, duly filled up, must be delivered, sealed and endorsed "Tender for Air Compressors, &c.," not later than 4 p.m. on Tuesday, the 11th February, 1913.

Dated this 16th day of January, 1913.

(By order)
SIDNEY H. CHAMBERS,
Surveyor.

Public Offices,
Hampton, Middlesex. 287

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

Four-wheeled 15-ton Oil Tank Wagons.	Wrought Iron (Grade B).
Screw Couplings.	Galvanised Wrought Iron, Water Tubes, &c.
Fencing Materials.	Acid Open-hearth Steel Boiler Plates.
Wrought Iron (Cable Quality).	Leather Belting, &c.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

Tenders must be delivered in sealed envelopes, addressed to the undersigned, marked "Tender for Four-wheeled 15-ton Oil Tank Wagons," or as the case may be, not later than 11 o'clock a.m. on Thursday, the 30th January, 1913.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C., London,
22nd January, 1913. 368

The Orkney Harbours ComMISSIONERS invite TENDERS for DREDGING at Whitehall Harbour, Stronsay, Orkney. Quantity of material to be dredged estimated at 90,000 cubic yards, also at Kirkwall Harbour, Orkney. Quantity of material to be dredged estimated at 4000 cubic yards.

For further particulars apply to the subscriber, who will exhibit the plans and specifications, and who will receive offers up to 8th February, 1913.

The Commissioners do not bind themselves to accept the lowest or any Tender.

D. J. ROBERTSON,
Clerk to the Commissioners.

Kirkwall,
13th January, 1913. 289

The South Indian Railway COMPANY, Limited, are prepared to receive TENDERS for the SUPPLY of:—

1. ROLLING STOCK (Broad Gauge),
   35 60ft. Carriage Underframes.
2. ROLLING STOCK (Metre Gauge),
   90 Steel-covered Goods Bogie Wagons.
   20 Steel High-sided Bogie Wagons and 5 Steel Brake Vans.
3. WHEELS and AXLES,
   1282 Pairs Disc Wheels and Axles.
4. SPRINGS, Laminated, Volute and Helical.
5. CARRIAGE FITTINGS (Broad Gauge),
   Comprising Wrought Iron and Steel, Hardware, Glass, Screws and Sundries.
6. CARRIAGE FITTINGS (Metre Gauge),
   Comprising Wrought Iron and Steel, Hardware, Glass, Screws and Sundries.

Specifications and forms of Tender may be obtained at the Company's Offices.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Rolling Stock," or as the case may be, must be left with the undersigned not later than One o'clock on Wednesday, the 5th February, 1913.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 40s. for each copy of specifications Nos. 1, 2 and 3, and 20s. for each copy of specifications Nos. 4, 5, 6.

Copies of the drawings may be obtained on payment at the office of Robert White, Esq., M. Inst. C.E., Consulting Engineer to the Company, 3, Victoria-street, Westminster, S.W.

By order,
V. E. DE BROË, M. Inst. C.E.,
for Managing Director.

Company's Offices,
91, York-street, Westminster, S.W.,
24th January, 1913. 339

City of Westminster. — The Westminster City Council invite APPLICATIONS for the POSITION of ASSISTANT SURVEYOR, at a salary of £300 per annum, rising by annual increments of £10 to £350 per annum, from properly qualified persons not exceeding 35 years of age.

Applicants must be associate members of the Institute of Civil Engineers, and have had practical experience in municipal engineering work.

The person appointed will be required to reside within the City.

Personal canvassing of members of the Council is strictly prohibited, and is held to be a disqualification.

Applications to be made on printed forms, to be obtained from and delivered to the undersigned not later than the first post on Saturday, 1st February, 1913.

JOHN HUNT,
Town Clerk.

Westminster City Hall,
Charing Cross-road, W.C.,
16th January, 1913. 303

County Borough of WolverHAMPTON.
APPOINTMENT OF ELECTRICAL ENGINEER AND MANAGER.

The Council of the County Borough of Wolverhampton invite APPLICATIONS for the POSITION of ENGINEER and MANAGER of their Electricity Undertaking.

Candidates must have had considerable experience in important electricity undertakings and have a sound knowledge of the commercial management of electricity supply. The successful candidate will be required to give the whole of his time to the conduct of the business.

A commencing salary of £600 will be paid.

Age not to exceed 40 years.

Wanted, for Abroad, Chief ENGINEER, accustomed to erecting and running large Ammonia Refrigerating Machines. Must be a reliable man, and single. Age not over 35. Preference given to a man with drawing-office experience. Good opening for the right man.—Address, 338, Engineer Office, 33, Norfolk-street, Strand, W.C. 338 A

Wanted, Mining Engineer. Must be in a position to take up some Shares in Company after inspection of mines to give confidence to other shareholders.—Address, 212, Engineer Office, 33, Norfolk-street, Strand, W.C. 212 A

Wanted, Smart Young English ENGINEERS, with technical and practical training, to SUPERVISE the RUNNING of MOTOR OMNIBUSES on the Continent. Must be able to speak German fluently, and have had previous experience in this class of work. Only thoroughly keen young men of first-class training need apply.—Letters only to COMMERCIAL VEHICLE DEPT., the Daimler Company, Limited, Coventry. 327 A

Wood Distillation.—A Firm of Engineers who propose specialising in above REQUIRES the SERVICES of a competent MAN with thorough practical and theoretical experience.—Address, 310, Engineer Office, 33, Norfolk-street, Strand, W.C. 310 A

Assistant to Works Manager WANTED for Motor Car Works in the North of England. Must be young and energetic, with first-class experience of machine tools and rapid production.—Address, stating full experience, age and salary required, to 352, Engineer Office, 33, Norfolk-street, Strand, W.C. 352 A

Diesel Engines.—Company to be formed shortly will REQUIRE, for their new Diesel engine works, ENGINEERS and STAFF experienced in the building and sale of Diesel Engines.—Applications to 357, Engineer Office, 33, Norfolk-street, Strand, W.C. 357 A

Junior Assistant (Young) Wanted to look after inspection and testing of materials and supervise heat treatment of same. Must have good technical training. Some shop experience would be an advantage.—Address, stating age and salary required, saying details of training and experience, to P33, Engineer Office, 33, Norfolk-street, Strand, W.C. P33 A

Required, in the Neighbourhood of Bristol, ASSISTANT to WORKS MANAGER; applicant must have had workshop training in motor car or similar work, and be well up in autogenous welding, brazing, and sheet metal manipulation, also use of light machine tools; some drawing-office experience essential; must possess organising power.—Reply, in confidence, stating age, experience, and salary required, and when last engaged, to 311, Engineer Office, 33, Norfolk-street, Strand, W.C. 311 A

Required, the Services of an experienced ENGINEER with up-to-date knowledge of Motor Vehicle Construction and Operation. Must have held responsible position in executive control.—Applications to be addressed to WALTER J. IDEN, Chief Engineer, London General Omnibus Co., Ltd., 9, Grosvenor-road, Westminster, S.W. 309 A

To Consulting Engineers and OTHERS.—The Chief Engineer of a large Works DESIRES to MEET with a thoroughly-trained ENGINEER to act as his ASSISTANT. An all-round knowledge of internal combustion engines is essential. The position is a permanency, and offers exceptional opportunities for advancement. A liberal salary will be paid to the right man, and all applications will be treated in strict confidence.—Address, 320, Engineer Office, 33, Norfolk-street, Strand, W.C. 320 A

Wanted at Once, Competent JIG DRAUGHTSMAN for Works Office.—State age, experience, and salary required, to ROBEY and CO., Ltd., Lincoln. 297 A

Wanted, First-Class DraughtsMAN, with expert knowledge Semi-Diesel Horizontal Crude Oil Engines, four-cycle type. Good opening to suitable man.—Full particulars, in confidence, to SECRETARY, Fielding and Platt, Gloucester. 331 A

Wanted for Large Works in North of England, MECHANICAL DRAUGHTSMAN well up in Machine Tool Design; must have good technical and general education, and able to make himself useful in works.—Address, stating age, experience, and salary, to 150, Engineer Office, 33, Norfolk-street, Strand, W.C. 150 A

Wanted, Reliable Draughtsman with knowledge of Diesel Engines and accustomed to working out details.—Address, stating age, experience, and salary required, to 364, Engineer Office, 33, Norfolk-street, Strand, W.C. 364 A

Assistant Heating Draughtsman WANTED for Birmingham.—State age, where educated, and give full particulars of experience to 323, Engineer Office, 33, Norfolk-street, Strand, W.C. 323 A

Draughtsman Required, ExPERIENCED in Gas Producer Plant and Furnaces; must be quick, accurate, and accustomed to working out quantities.—State age, experience, salary, and when at liberty, to 325, Engineer Office, 33, Norfolk-street, Strand, W.C. 325 A

Draughtsman Required, Experienced in Crushing, Grinding and Cement Making Machinery.—Apply, stating age, experience and salary required, EDGAR ALLEN & CO., Ltd., Sheffield. 363 A

Draughtsman. — Required ImMEDIATELY first-class BOILER DRAUGHTSMAN, preference given to good designer and one with Marine or Gas Producer experience.—Reply, stating qualifications, age, and salary required, to Z.H. 333, care of, Messrs. Deacon's, Leadenhall-street, E.C. 365 A

Full particulars of Subscription and Advertisement rates are contained in "THE ENGINEER" DIRECTORY, an Abridged Index to the Editorial Columns, as well as "The Engineer" Iron and Steel Trades Directory and Buyers' Guide. A copy sent free on application to

33, NORFOLK STREET, STRAND, LONDON, W.C.

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LIFE ASSOCIATION

INSURANCES IN FORCE OVER £12,000,000

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£500	Will purchase a man of **65** an Annuity of **£57 9s. 6d**	**£1,000**	Will purchase a Man of **70** an Annuity of **£138 10s.**
£500	Will purchase a Woman of **60** an Annuity of **£43 15s. 6d.**	**£1,000**	Will purchase a Woman of **65** an Annuity of **£102 15s.**

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23–28 FLEET STREET, LONDON, E.C.

The Year-Book *of* Wireless Telegraphy & Telephony · 1913

The Year-Book *of* Wireless Telegraphy & Telephony · 1913

Price 2/6 *net*

LONDON:
Published for the Marconi Press Agency
Ltd., by The St. Catherine Press
Oswaldestre House, Norfolk Street, Strand, W.C.

CONTENTS

INDEX

NOTE.—The land and ship stations are not included in this index. They are grouped together under the countries in which the land stations are, or to which the ships belong, and these countries are arranged in the section in alphabetical order. Names not in the index should be sought under "Biographical Notices," where they are arranged in alphabetical order.

INDEX TO ADVERTISEMENTS

PREFACE

THE "Year Book of Wireless Telegraphy and Telephony," of which the present is the first issue, is the first volume of its kind to be offered to the public. The enormous interest, popular, scientific and commercial, in the rapid development of wireless telegraphy has led to an insistent demand for a thorough digest of information relating to the subject. No apology need be offered, therefore, for the present publication. To satisfy the requirements of every interest within a volume of reasonable dimensions was the problem to be faced in the compilation of the Year Book. There has been produced what, it is confidently hoped, will be a work at once indispensable to the rapidly-growing public that manifests an interest in wireless telegraphy, and of sound every-day service to the commercial and to the scientific man. The variety of matters relating to the subject is immense and constantly developing, and the aim has been so concisely to compile them that, whether he desire to know the wireless stations of the world or the rates for a message, to understand the laws and regulations governing wireless telegraphy, or to learn the progress of experimental work, the reader will be able to discover it with a minimum of effort. The volume, on its entry into the world, does not pretend to have attained to perfection ; therefore criticism and suggestions for rearrangement or incorporation of new features in the next edition will be welcomed by

THE EDITOR

Marconi House, Strand,
London, W.C.
April 1913.

G. Marconi, Esq., LL.D., D.Sc.

To face page 13]

JANUARY, 1913

1	W	Ship messages accepted at British post offices, 1905. Manchester Ship Canal opened, 1894. NEW YEAR'S DAY. Bank Holiday in Scotland.
2	Th	
3	F	
4	S	
5	**S**	2nd Sunday after Christmas.
6	M	Epiphany.
7	T	Calais lost, 1558.
8	W	
9	Th	
10	F	British Penny Postage established, 1840.
11	S	
12	**S**	1st Sunday after Epiphany.
13	M	
14	T	
15	W	Sandwich Islands discovered, 1778.
16	Th	
17	F	
18	S	German Empire proclaimed, 1871.
19	**S**	Septuagesima Sunday.
20	M	London Docks opened, 1805.
21	T	
22	W	
23	Th	"Republic" wrecked; passengers and crew saved, 1909.
24	F	
25	S	
26	**S**	Sexagesima Sunday.
27	M	
28	T	
29	W	Paris capitulated, 1871.
30	Th	
31	F	"Great Eastern" steamer launched, 1858.

FEBRUARY, 1913

1	S	
2	S	Quinquagesima. SHROVE SUNDAY.
3	M	
4	T	SHROVE TUESDAY.
5	W	ASH WEDNESDAY.
6	Th	
7	F	
8	S	
9	S	Quadragesima. First Sunday in Lent.
10	M	
11	T	
12	W	
13	Th	
14	F	
15	S	U.S.S. " Maine " destroyed, 1898.
16	S	2nd Sunday in Lent. Spanish & General Wireless Trust, Ltd., formed, 1912.
17	M	
18	T	
19	W	
20	Th	
21	F	British Radiotelegraph Action decided, 1911.
22	S	George Washington born, 1732. Prof. Hertz born, 1857; died January 1st, 1894.
23	S	3rd Sunday in Lent.
24	M	
25	T	
26	W	Wreck of troopship " Birkenhead," 1852.
27	Th	
28	F	

MARCH, 1913

1	S	Wireless service inaugurated Hawaiian Islands, 1901.
2	**S**	4th Sunday in Lent.
3	M	
4	T	INAUGURATION DAY, U.S.A.
5	W	
6	Th	
7	F	
8	S	
9	**S**	5th Sunday in Lent.
10	M	
11	T	
12	W	
13	Th	
14	F	Millwall Docks opened, 1868.
15	S	
16	**S**	PALM SUNDAY.
17	M	
18	T	
19	W	
20	Th	
21	F	GOOD FRIDAY.
22	S	
23	**S**	EASTER SUNDAY.
24	M	BANK HOLIDAY. H.M.S. "Eurydice" foundered, 1878.
25	T	
26	W	
27	Th	English Channel spanned by wireless, 1899.
28	F	
29	S	
30	**S**	1st Sunday after Easter. First transatlantic Marconigram published in *Times*, 1903.
31	M	

APRIL, 1913

1	T	*Marconigraph* first published, 1911.
2	W	
3	Th	
4	F	
5	S	
6	**S**	2nd Sunday after Easter. Peary reached North Pole, 1909.
7	M	
8	T	
9	W	
10	Th	
11	F	American Civil War commenced, 1861.
12	S	
13	**S**	3rd Sunday after Easter.
14	M	
15	T	"Titanic" disaster, 1912.
16	W	
17	Th	Tilbury Docks opened, 1886.
18	F	San Francisco Earthquake, 1906.
19	S	
20	**S**	4th Sunday after Easter.
21	M	
22	T	
23	W	
24	Th	Compagnie Française Maritime et Coloniale de Télégraphie sans Fil formed, 1903.
25	F	Commendatore G. Marconi, LL.D., D.Sc., born, 1874. Marconi International Marine Communication Co., Ltd., formed, 1900.
26	S	Four Sevens Patent, 1900.
27	**S**	ROGATION SUNDAY.
28	M	
29	T	
30	W	

MAY, 1913

1	Th	Ascension Day.
2	F	
3	S	
4	S	Sunday after Ascension.
5	M	Napoleon I. died, 1821.
6	T	
7	W	
8	Th	Treaty on " Alabama " claims, 1871.
9	F	
10	S	Lodge's Patent for Syntonic Wireless Telegraphy, 1897.
11	S	Whit Sunday.
12	M	Whit Monday.
13	T	Whit Tuesday. Hudson's Bay Co. founded, 1670.
14	W	
15	Th	
16	F	
17	S	
18	S	Trinity Sunday. New Eddystone Lighthouse opened, 1882.
19	M	
20	T	Christopher Columbus died, 1506.
21	W	" Lake Champlain," first British merchant vessel with wireless, left Liverpool, 1901. Manchester Ship Canal opened, 1894.
22	Th	
23	F	
24	S	
25	S	1st Sunday after Trinity. Lloyds incorporated, 1871.
26	M	
27	T	
28	W	
29	Th	
30	F	Decoration Day. General Holiday in U.S.A.
31	S	Union Day, South Africa.

JUNE, 1913

1	S	2nd Sunday after Trinity.
2	M	First British Wireless Patent granted, 1896.
3	T	First paid Marconigram sent by Lord Kelvin, 1898.
4	W	International Radiotelegraphic Conference, London, 1912.
5	Th	
6	F	
7	S	First Reform Bill, 1832.
8	S	3rd Sunday after Trinity.
9	M	
10	T	
11	W	
12	Th	Sir Oliver Lodge born, 1851.
13	F	
14	S	
15	S	4th Sunday after Trinity. Magna Charta, 1215.
16	M	" Drummond Castle " lost, 1896.
17	T	
18	W	Battle of Waterloo, 1815.
19	Th	"Alabama" sunk by "Kearsage," 1864.
20	F	Kingstown Regatta reported by wireless, 1898.
21	S	
22	S	5th Sunday after Trinity. H.M.S. " Victoria " sunk, 1893.
23	M	
24	T	
25	W	
26	Th	Lord Kelvin born, 1824.
27	F	
28	S	
29	S	6th Sunday after Trinity.
30	M	Tower Bridge opened, 1894.

JULY, 1913

1	T	
2	W	
3	Th	
4	F	British Admiralty agree to take Marconi apparatus, 1900. INDEPENDENCE DAY, U.S.A., 1776
5	S	International Radio-Telegraph Convention signed in London, 1912.
6	S	7th Sunday after Trinity.
7	M	
8	T	
9	W	
10	Th	Captain Marryat, novelist, born, 1792.
11	F	
12	S	
13	S	8th Sunday after Trinity. Treaty of Berlin, 1878.
14	M	
15	T	
16	W	
17	Th	
18	F	Barry Docks opened, 1889.
19	S	
20	S	9th Sunday after Trinity. Wireless Telegraph & Signal Co., Ltd., formed, 1897 (Name changed to Marconi's Wireless Telegraph Co., Ltd., March 24th, 1900).
21	M	
22	T	
23	W	
24	Th	Marconi apparatus installed generally on British warships, 1903.
25	F	
26	S	
27	S	10th Sunday after Trinity. Bank of England founded, 1694.
28	M	The " Alabama " sailed from the Mersey, 1862.
29	T	
30	W	
31	Th	

AUGUST, 1913

1	F	
2	S	
3	S	11th Sunday after Trinity. Columbus's first voyage, 1492.
4	M	Bank Holiday. East India Docks opened, 1806. Southampton Docks opened, 1895. First International Conference on Wireless Telegraphy met at Berlin, 1903.
5	T	First British American Cable worked, 1858.
6	W	
7	Th	
8	F	
9	S	
10	S	12th Sunday after Trinity. Royal Observatory, Greenwich, founded, 1675.
11	M	
12	T	
13	W	
14	Th	
15	F	Wireless Telegraph Act of Great Britain passed, 1904.
16	S	First steam journey to India, 1825.
17	S	13th Sunday after Trinity.
18	M	
19	T	
20	W	
21	Th	
22	F	Wireless news message service to liners inaugurated, 1903.
23	S	
24	S	14th Sunday after Trinity. Victoria Tubular Bridge opened, 1860.
25	M	
26	T	West India Docks opened, 1802.
27	W	
28	Th	Loss of " Royal George," 1782.
29	F	
30	S	
31	S	15th Sunday after Trinity.

SEPTEMBER, 1913

1	M	
2	T	Board of Trade constituted, 1786.
3	W	
4	Th	
5	F	Malta taken, 1800.
6	S	" Mayflower " sailed from England, 1620.
7	**S**	16th Sunday after Trinity.
8	M	Sebastopol taken, 1855.
9	T	
10	W	
11	Th	
12	F	
13	S	Capture of Quebec, 1759.
14	**S**	17th Sunday after Trinity.
15	M	Liverpool and Manchester Railway opened, 1830.
16	T	
17	W	
18	Th	
19	F	
20	S	
21	**S**	18th Sunday after Trinity.
22	M	Michael Faraday born, 1791.
23	T	
24	W	
25	Th	
26	F	
27	S	
28	**S**	19th Sunday after Trinity. Strasburg capitulated, 1870.
29	M	
30	T	

OCTOBER, 1913

1	W	
2	Th	
3	F	International Conference met at Berlin, 1906.
4	S	
5	S	20th Sunday after Trinity.
6	M	
7	T	Marconi Press Agency formed, 1910.
8	W	Russian Wireless Company formed, 1908.
9	Th	
10	F	
11	S	
12	S	21st Sunday after Trinity. Robert Stephenson died, 1859.
13	M	
14	T	
15	W	The Gregorian Calendar introduced, 1582.
16	Th	
17	F	Transatlantic stations opened for public service, 1907.
18	S	
19	S	22nd Sunday after Trinity.
20	M	
21	T	Trafalgar Day, 1805.
22	W	
23	Th	
24	F	
25	S	St. Katherine Docks opened, 1828.
26	S	23rd Sunday after Trinity. Compagnie de Télégraphie sans Fil formed, 1901.
27	M	
28	T	Present Royal Exchange opened, 1844.
29	W	
30	Th	
31	F	

NOVEMBER, 1913

1	S	
2	**S**	24th Sunday after Trinity.
3	M	Berlin Convention (International Radiotelegraphic) signed, 1906.
4	T	
5	W	Professor Clerk Maxwell died, 1879.
6	Th	
7	F	*London Gazette* established, 1665.
8	S	American Marconi Company incorporated, 1899.
9	**S**	25th Sunday after Trinity.
10	M	
11	T	
12	W	
13	Th	Professor Clerk Maxwell born, 1831.
14	F	
15	S	*Transatlantic Times* published at sea, 1899.
16	**S**	26th Sunday after Trinity.
17	M	Suez Canal opened, 1869.
18	T	
19	W	Ferdinand de Lesseps born, 1805.
20	Th	
21	F	
22	S	
23	**S**	27th Sunday after Trinity.
24	M	Tasmania discovered, 1642.
25	T	
26	W	
27	Th	
28	F	
29	S	
30	**S**	1st Sunday in Advent.

DECEMBER, 1913

1	M	
2	T	
3	W	
4	Th	
5	F	
6	S	
7	S	2nd Sunday in Advent. Ferdinand de Lesseps died, 1894.
8	M	
9	T	
10	W	Royal Academy instituted, 1768.
11	Th	
12	F	First wireless signals transmitted across Atlantic, 1901.
13	S	"Delhi" accident, 1911.
14	S	3rd Sunday in Advent. George Washington died, 1799.
15	M	Amundsen reaches South Pole, 1911.
16	T	
17	W	First Transatlantic wireless message sent, 1902.
18	Th	
19	F	
20	S	
21	S	4th Sunday in Advent.
22	M	
23	T	
24	W	Wireless communication with East Goodwin lightship, 1898. Spanish Marconi Company formed, 1910.
25	Th	CHRISTMAS DAY.
26	F	BANK HOLIDAY.
27	S	
28	S	1st Sunday after Christmas.
29	M	
30	T	
31	W	

MUHAMMADAN CALENDAR
(1331st Year of Hejira, A.D. 1912-1913).

Year of Hejira, 1331.	A.D. 1912.
Muharram	Dec. 11
	A.D. 1913.
Saphar	Jan. 10
Rabia I.	Feb. 8
Rabia II.	March 10
Jomada I.	April 8
Jomada II.	May 8
Rajab	June 6
Shaaban	July 6
Ramadan	Aug. 4
Shawall	Sept. 3
Dulkaada	Oct. 2
Dulheggia	Nov. 1
1332.	
Muharram	Nov. 30
Saphar	Dec. 30

OLD STYLE CALENDAR
(Used in Russia and Greece).

A.D. 1912, A.M. 7420.

Old Style.	Certain Holy Days.	New Style.
Jan. 1	Circumcision	Jan. 14
„ 6	Theophany (Epiphany)	„ 19
Feb. 2	Hypapante	Feb. 15
„ 24	Carnival Sunday	Mar. 9
Mar. 3	First Sunday in Lent	„ 16
„ 9	Forty Martyrs	„ 22
„ 25	Annunciation of Theotokos	April 7
April 7	Palm Sunday	„ 20
„ 12	Great Friday	„ 25
„ 14	Holy Pasch	„ 27
„ 23	St. George	May 9
May 9	St. Nicolas	„ 22
„ 14	Coronation of the Emperor *	„ 27
„ 23	Ascension	June 5
June 2	Pentecost	„ 15
„ 3	Holy Ghost	„ 16
„ 29	Peter and Paul, Chief Apostles	July 12
Aug. 1	First days of Fast of Theotokos	Aug. 14
„ 6	Transfiguration	„ 19
„ 15	Repose of Theotokos (Assumption)	„ 28
„ 30	St. Alexander (Nevsky)	Sept. 12
Sept. 8	Nativity of Theotokos	„ 21
„ 14	Exaltation of the Cross	„ 27
Oct. 1	Patronage of Theotokos *	Oct. 14
„ 21	Accession of the Emperor *	Nov. 3
Nov. 15	First day Fast of the Nativity	„ 28
„ 21	Entrance of Theotokos...	Dec. 4
Dec. 6	St. Nicolas	„ 19
„ 9	Conception of Theotokos	„ 22
25	Nativity	Jan. 7

* Peculiar to Russia.

JEWISH CALENDAR

(A.M. 5673 and part of A.M. 5674).

A.M 5673.		A.D. 1912.	
Tishri	1	Sept. 12	First Day of New Year
,,	4	,, 15	Fast of Guedaliah
,,	10	,, 21	Day of Atonement
,,	15	,, 26	Feast of Tabernacles
,,	21	Oct. 2	Hosana Rabah
,,	22	,, 3	Feast of the 8th day
,,	23	,, 4	Rejoicing of the Law
Hesvan	1	,, 12	New Moon
Kislev	1	Nov. 11	New Moon
,,	25	Dec. 5	Dedication of the Temple
Tebet	1	,, 11	New Moon
,,	10	,, 20	Fast. Siege of Jerusalem
		A.D. 1913.	
Sebat	1	Jan. 9	New Moon
Adar	1	Feb. 8	New Moon
Veadar	1	Mar. 10	New Moon
,,	11	,, 20	Fast of Esther
,,	14	,, 23	Purim
,,	15	,, 24	Shusan
Nisan	1	April 8	New Moon
,,	15	,, 22	Festival of Passover
,,	16	,, 23	Festival of Passover, 2nd day
,,	21	,, 28	Festival of Passover, 7th day
,,	22	,, 29	Festival of Passover ends
Iyar	1	May 8	New Moon
Sivan	1	June 6	New Moon
,,	6	,, 11	Festival of Weeks
Tamuz	1	July 6	New Moon
,,	17	,, 22	Fast of Tamuz
Ab.	1	Aug. 4	New Moon
,,	9	,, 12	Fast of Ab.
Elul	1	Sept. 3	New Moon
A.M. 5674.			
Tishri	1	Oct. 2	First day of New Year
,,	2	,, 2	Second day of New Year
,,	4	,, 5	Fast of Guedaliah
,,	10	,, 11	Day of Atonement
,,	15	,, 16	Feast of Tabernacles
,,	21	,, 22	Hosana Rabah
,,	22	,, 23	Feast of the 8th day
,,	23	,, 24	Rejoicing of the Law
Hesvan	1	Nov. 1	New Moon
Kislev	1	,, 30	New Moon
,,	25	Dec. 24	Dedication of the Temple
Tebet	1	,, 30	New Moon

NOTE.—All Jewish Sabbaths and Festivals commence the previous evening at sunset.

YEARLY RECORD

OF THE

PROGRESS OF WIRELESS TELEGRAPHY

1896.

IN February, 1896, Mr. Marconi came to England. His first experiments in this country were conducted at Westbourne Park.

On June 2nd Mr. Marconi lodged his application for the first British Patent for Wireless Telegraphy, No. 12,039 of 1896.

In July of that year he was introduced to Sir (then Mr.) W. H. Preece, the Chief Electrical Engineer of the Post Office, at whose request Mr. Marconi conducted experiments before the officials of the Post Office, first over a distance of about 100 yards and afterwards between the General Post Office and the Savings Bank Department in Queen Victoria Street. Shortly afterwards a series of trials were conducted by Mr. Marconi before Post Office officials and naval and military officers on Salisbury Plain, when communication was successfully established over a distance of 1¾ miles.

On December 11th, 1896, Sir (then Mr.) W. H. Preece delivered a lecture at Toynbee Hall on "Telegraphy without Wires." Mr. Marconi was present at this lecture, and conducted the experiments.

1897.

In March, 1897, Mr. Marconi gave a demonstration on Salisbury Plain before the representatives of various Government Departments, communication being established over a distance of 4 miles.

On June 4th Mr. W. H. Preece lectured at the Royal Institution on the subject of Wireless Telegraphy.

In May further trials were made across the Bristol Channel between Lavernock and Flatholm, a distance of over 3 miles; and on the 13th of that month communication was established between Lavernock Point and Brean Down, a distance of about 8 miles. Professor Slaby, a German scientist, was present at these trials.

In July Mr. Marconi was called to Italy by the Italian

Minister of Marine, and gave a demonstration of his invention in the Admiralty buildings at Rome, and before King Humbert at the Royal Palace of the Quirinal. Between July 10th and 18th trials were made at Spezia at the request of the Italian Government, and on the 17th and 18th communication was successfully made and maintained between the Arsenal of San Bartolomeo at Spezia and the Italian cruiser *San Martin* at sea, at distances up to 16 k.m.

On July 20th, 1897, the Wireless Telegraph and Signal Company, Limited, was incorporated, with a capital of £100,000, to acquire Mr. Marconi's patents in all countries except Italy and her dependencies.

On August 27th, 1897, a lecture was given by Professor Slaby at the Sailors' Home, Potsdam, on Wireless Telegraphy, before the Emperor and Empress of Germany and the King of Spain.

In September and October further experiments were conducted by Mr. Marconi on Salisbury Plain for Post Office officials. Experiments were also carried out by officials of the Post Office at Dover. Receiving apparatus was erected by a Post Office official at Bath, and signals were received from Salisbury, 34 miles distant.

In November the first Marconi Station was erected at the Needles, Alum Bay, Isle of Wight. Experiments were conducted between that Station and Madeira House, South Cliff, Bournemouth, where Mr. Marconi was residing at the time, a distance of 14½ miles.

In December tests were made between the Station at Alum Bay and a steamer, the height of the mast being about 60 ft., and readable signals were obtained up to a distance of 18 miles, Captain Kennedy, R.E., being present.

1898.

In May, 1898, experiments were carried out by Mr. Marconi between St. Thomas's Hospital and the House of Commons. In the same month experiments were carried out at the request of Lloyd's between Ballycastle and Rathlin Island, a distance of 7½ miles.

On June 3rd Lord Kelvin visited the Needles Station and sent from there, to his friend Sir George Stokes, the first paid Marconigram.

On July 20th and 22nd the events of the Kingstown Regatta

The Rt. Hon. H. L. Samuel, M.P.
(British Postmaster-General).

[*To face page* 28

in Dublin were reported by wireless telegraphy for the Dublin *Daily Express* from the steamer *Flying Huntress,* equipped with the Marconi system.

On August 3rd wireless telegraphic communication was established between the Royal yacht *Osborne* and Ladywood Cottage, Osborne, in order that Queen Victoria might communicate with the Prince of Wales, then suffering from the results of an accident to his knee. Constant and uninterrupted communication was maintained during the sixteen days the system was in use.

In September the installation at Madeira House, Bournemouth, was removed to Poole Harbour, Dorset.

Under arrangement with the Trinity House officials the utility and value of wireless telegraphy as a means of communication between lightships and the shore was demonstrated by the installation in December, 1898, of the East Goodwin Lightship and the South Foreland Lighthouse. The intervening distance was 12 miles. Communication was first established on Christmas Eve, and was continuously maintained for more than a year.

1899.

During a gale in January, 1899, a heavy sea struck the East Goodwin Lightship, carrying part of her bulwarks away. The mishap was reported by wireless telegraphy to Trinity House.

On March 2nd Mr. Marconi read a paper on Wireless Telegraphy at the Institution of Electrical Engineers.

On March 3rd the s.s. *R. F. Matthews* ran into the East Goodwin Lightship. The accident was reported by wireless telegraphy to the South Foreland Lighthouse, and lifeboats were promptly sent to the assistance of the lightship.

On March 27th communication was established across the Straits of Dover, between the Chalet d'Artois, Wimereux, near Boulogne, and the South Foreland Lighthouse.

During the naval manœuvres in July three British warships, the flagship *Alexandra* and the cruisers *Europa* and *Juno* were equipped with Marconi apparatus, and messages were correctly exchanged between these vessels at distances up to 74 nautical miles (about 85 land miles).

In September Marconi Stations were installed at Chelmsford and Dovercourt.

During the meetings of the British Association at Dover and of the Association Française pour l'Avancement de Science at Boulogne, in August, communication between the two societies

was maintained by means of Marconi apparatus installed at the Dover Town Hall and at Wimereux.

The international yacht races between the *Shamrock* and the *Columbia,* which took place in September and October, 1899, were reported by wireless telegraphy for the *New York Herald.* After the conclusion of the races, series of trials were made at the request of the U.S.A. naval authorities between the cruiser *New York* and the battleship *Massachusetts,* signals being exchanged between the vessels at distances up to about 36 miles. On the return journey from America Mr. Marconi fitted the s.s. *St. Paul* with his apparatus, and on November 15th established communication with the Needles Station when 36 miles distant. Reports of the progress of the war in South Africa were telegraphed to the vessel, and were published in a leaflet entitled "The Transatlantic Times," printed on board the *St. Paul.*

In October, 1899, the War Office adopted the Marconi apparatus for use in the field in South Africa, and on November 2nd six of the company's electricians left for South Africa with six sets of Marconi apparatus. The apparatus proved of considerable service to the army and to the naval squadron in Delagoa Bay, to which several of the sets were subsequently transferred.

1900.

On February 2nd Mr. Marconi delivered a discourse on Wireless Telegraphy at the Royal Institution.

In March the Marconi system was adopted by the Norddeutscher Lloyd Steamship Company, and by agreement with this company Marconi apparatus was installed on the Borkum Riff Lightship and Borkum Lighthouse, and on board the R.M.S. *Kaiser Wilhelm der Grosse.*

On April 25th the Marconi International Marine Communication Company was incorporated with offices in London and Brussels, and agencies in Paris and Rome, for the maritime working of the Marconi system of wireless telegraphy.

On July 4th a contract was entered into by the Admiralty for the installation of the Marconi apparatus on certain of His Majesty's ships and at a number of coast stations. Twenty-six (26) sets were subsequently installed on ships of His Majesty's Navy, and six (6) at Admiralty Coast Stations. In addition to these installations, the six installations supplied to the War Office for field operations in South Africa were transferred to His Majesty's Navy.

In October the erection of the High Power Station at Poldhu was commenced. The aerials were at first supported by 20 masts, each 210 ft. high. The erection of a similar station at Cape Cod, Mass., was commenced early in the following year.

In November, 1900, the Belgian Royal Mail Steam Packet *Princesse Clementine,* plying between Ostend and Dover, was fitted, and a Marconi Wireless Telegraph Station installed at La Panne, on the Belgian coast near Ostend.

The Marconi system was adopted by Metropolitan Fire Brigade, and apparatus fitted at Mitcham Lane Station Box and Streatham Fire Station.

1901.

On January 1st, 1901, the *Princesse Clementine* reported the barque *Medora,* of Stockholm, waterlogged on Ratel Bank. A tug was promptly despatched from Ostend and the barque towed off.

On January 8th wireless telegraph experiments on *Princesse Clementine* were carried out during a storm, communication being maintained the whole way from Ostend to Dover. On January 19th *Princesse Clementine* ran ashore at Mariakerke during a thick fog. News of the accident was conveyed to Ostend by wireless telegraphy.

In February communication was established between Niton Station, St. Catherines, I. of W., and the Lizard Station, a distance of 196 miles.

The Marconi system of wireless telegraphy was largely used during the voyage of the Duke and Duchess of York to Australia in 1901.

On March 1st a public Marconi Telegraph Service was inaugurated between five of the principal islands of the Hawaiian group, viz., Oahu, Kauai, Molaki, Maui, and Hawaii.

In April a demonstration of the Marconi system was carried out for the French Government, communication being successfully established and maintained for some time between a Station at Calvi, Corsica, and another at Antibes in the Riviera. The Prince of Monaco's yacht was also fitted with Marconi apparatus at the same time for the purpose of demonstrating to the delegates of "Congress International de l'Association de la Marine" the value of the Marconi system for maritime communication.

In May the Canadian Government decided to instal Marconi apparatus at two stations on the Straits of Belle Isle.

On April 26th the Postmaster-General, Lord Londonderry, received a deputation of the directors of the Marconi Companies.

On May 15th, 1901, Mr. Marconi read a paper on Syntonic Wireless Telegraphy at the Royal Society of Arts, London.

The first British ship, the s.s. *Lake Champlain* (Beaver Line), was equipped by the Marconi Company with wireless telegraphic apparatus on May 21st, and about the same date the Marconi Company opened six coast stations in England and Ireland for communication with ships at sea as follows:—Crookhaven, Co. Cork; Rosslare, Co. Wexford; Holyhead; Withernsea, near Hull; Caister, near Yarmouth; North Foreland.

The Canadian Government ordered two Marconi stations to be erected on the Straits of Belle Isle. June 1st, two stations ordered by the *New York Herald* for Nantucket Island and Nantucket Lightship.

On July 23rd the Government of the Congo ordered for Banana (Congo) and Ambrizette (Angola) two stations.

The masts at Poldhu were wrecked during a very heavy gale on September 20th, and the masts at Cape Cod shared a like fate in the November following. The masts were then replaced by four towers, 210 ft. high, built of timber.

On September 26th a 14 years' contract was made for the installation of the Marconi apparatus at ten of Lloyd's Signal Stations.

A school for training wireless engineers was opened at Frinton-on-Sea in September, and on October 12th Stations for Commercial Service were opened at Niton, Isle of Wight, and the Lizard, Cornwall.

The Compagnie de Telegraphie sans Fil of Brussels was formed on October 26th to develop and work the Marconi system on the Continent.

Signals were received by Mr. Marconi at St. Johns, Newfoundland, from Poldhu Station, Cornwall, a distance of 1,800 miles, across the Atlantic on December 12th and 13th.

1902.

Considerable progress in Transatlantic work was accomplished, and also in long-distance communication throughout Europe. In February Mr. Marconi received on board the s.s. *Philadelphia*, of the America Line, readable messages up to a distance of 1,551½ statute miles, and Morse signals up to a distance of 2,099 statute miles from Poldhu Station, Cornwall.

Wireless telegraphy was considerably used in operations for the refloating of the destroyer *Recruit,* struck in Brissons in a fog on May 28th.

Mr. Marconi lectured on the "Progress of Electric Space Telegraphy" at the Royal Institution of Great Britain on June 13th.

On July 14th-16th Mr. Marconi received messages from Poldhu on the Italian battleship *Carlo Alberto,* lying at Cape Skagen, a distance of 800 miles; and at Kronstadt, 1,600 miles.

A demonstration was given before officials of the Dutch Government of Mr. Marconi's inventions, and the Colonial Premiers who were in England for King Edward's Coronation witnessed a demonstration of the Marconi system on board the *Koh-i-nor.*

The Marconi Wireless Telegraph Company of Canada was formed on November 1st, and in December wireless messages were despatched by the Cape Breton Station from Mr. Marconi and from the Earl Minto to His Majesty King Edward VII. Mr. Marconi also sent a message to King Victor Emmanuel of Italy. Mr. Marconi was made a member of the Italian Order of Merit.

The American Marconi Company was established in this year.

1903.

President Roosevelt sent a Transatlantic message to King Edward *viâ* Cape Cod and Poldhu Stations on January 19th. High power and other stations were ordered by the Italian Government, and the Italian Senate and Chamber of Deputies tendered a vote of thanks to Mr. Marconi for the results obtained in the Italian Navy with wireless telegraphy.

The first Transatlantic Marconigram was published in *The Times* on March 30th.

The Compagnie Française Maritime and Coloniale de Télégraphie Sans Fil was formed on April 24th to operate the Marconi system in France.

An agreement was made on July 24th by the British Admiralty for the general use of the Marconi system in the Navy.

The first International Conference upon Wireless Telegraphy was held in Berlin on August 4th.

Mr. Marconi sailed from Liverpool on the s.s. *Lucania* on August 22nd, and during the voyage news messages were received daily,

The passengers of the Red Star Liner *Kroonland,* which was disabled on December 8th, 130 miles west of the Fastnet, were saved great inconvenience by wireless communication being established with the Marconi Station at Crookhaven.

Mr. Marconi was made a Knight of the Order of St. Anne of Russia.

1904.

On April 28th a contract was made by the Admiralty for the installation of a coast station at Guernsey.

A Wireless Telegraph Act was passed by the British Government on August 15th.

Meteorological information was supplied by wireless to the *Daily Telegraph.*

Accidents to s.s. *New York* and the s.s. *Friesland* early in the year were reported by wireless telegraphy.

During the year contracts were carried out by the Marconi Company for the Montenegrin, Russian, Italian, and Canadian Governments; also for the Sicilian Railway. In August an arrangement was made by the Postmaster-General whereby British post offices undertook the collection, transmission and delivery of long-distance and ship-to-shore messages on behalf of the Marconi Company.

1905.

Judgment given by Judge Townsend in New York on May 4th in favour of the Marconi Company in its action against the De Forest Wireless Telegraph Company for infringement of patents. On May 12th the Canadian Government ordered stations for Cape Sable (N.S.) and St. John (N.B.), and on May 30th instructions were given for five further lightships to be installed with wireless apparatus for Trinity House.

Erection of the Clifden High-Power Station (Ireland) was commenced in October.

Mr. Marconi was made a Civil Member of the Royal Order of Savoy.

In 1905 Mr. Marconi took out his patent for the horizontal directional aerial (No. 14,788), which marked a step of great importance in the progress of long-distance work.

1906.

A contract made by the British Post Office in May for the erection of stations at Tobermory and Loch Boisdale, Scotland, by the Marconi Company.

On August 4th the Argentine Marconi Company was formed to work the Marconi patents in Argentine and Uruguay.

In October and November an International Radiotelegraphic Conference was held at Berlin, and a convention was signed by the majority of the principal countries of the world.

1907.

Marconi Transatlantic Stations at Clifden and Glace Bay were opened for limited public service on October 17th.

1908.

Transatlantic Stations were opened to the general public for transmission of messages between the United Kingdom and the principal towns in Canada on February 3rd.

Mr. Marconi lectured on "The Commercial Application of Wireless Telegraphy" at Liverpool on February 24th.

The Russian Company of Wireless Telegraphs and Telephones was formed on October 8th.

1909.

The *Republic,* after collision with the s.s. *Florida* off the coast of the United States on January 23rd, succeeded in calling assistance by wireless, with the result that all her passengers and crew were saved before the vessel sank.

Mr. Marconi lectured before the Dutch Royal Institute of Engineers on May 1st and on December 11th.

The *Slavonia* was stranded in the Azores on June 10th, when the passengers and crew, numbering 410, were rescued from the wreck by the assistance of vessels summoned to her aid by wireless.

Glace Bay Transatlantic Station was destroyed by fire in August.

The Marconi British Coast Stations taken over by the Postmaster-General on September 29th, who was granted a licence to use the company's patents.

Mr. Marconi was awarded the Nobel Prize for Physics when he lectured at the Royal Academy of Science, Stockholm.

During the year the Brazilian Government ordered from the Marconi Company four stations, and the Madeira Mamore Railway two stations at Mañaos and Porto Velho, 540 miles apart. A contract obtained by the Marconi Company for the erection of a station at Varna for the Bulgarian Government.

1910.

Mr. Godfrey Isaacs joined the Board of the Marconi Company on January 25th.

Glace Bay Station was restored and reopened for public service on April 23rd.

Mr. Marconi, *en route* for Buenos Aires on board the *Principessa Mafalda,* received messages from Clifden at a distance of 4,000 miles by day and 6,735 miles by night.

The important patents of Professor Majorana for wireless telephony were acquired by Marconi's Wireless Telegraph Company.

The Compania Nacional de Telegrafia sin Hilos was formed on December 24th to operate the Marconi system in Spain.

1911.

On February 21st judgment was given in the action instituted in December, 1910, by the Marconi Company against the British Radiotelegraph and Telephone Company for infringement of their tuning patent No. 7,777 of 1900. Mr. Justice Parker's decision was in favour of the Marconi Company, and he granted them a certificate of validity of their patent and an injunction, together with costs and damages.

The first number of the MARCONIGRAPH, an illustrated magazine of wireless telegraphy, was issued in April.

A contract was made between the Marconi Company and the Canadian Government for operating of wireless telegraph stations in Canada for a period of 20 years.

Stations at Teneriffe, Cadiz, Barcelona, and Las Palmas, erected by Marconi Company, were opened for public business by the Cia Nacioñal de Telegrafia sin Hilos, the concessionaires of the public wireless telegraph service of Spain.

The Imperial Conference held in May approved the proposal that an Imperial Wireless Telegraph System should be created.

H.M.S. *Cornwall* reported by wireless as being ashore at Cape Sable (N.S.), and the Donaldson Liner *Saturnia* as having struck an iceberg 175 miles east of Belle Isle. Both vessels safely brought to port.

Mr. Marconi lectured on "Radiotelegraphy" at Royal Institution on June 2nd.

The P. and O. Liner *Delhi,* with the Duke and Duchess of Fife on board, was reported in distress off Cape Spartel on December 13th. Assistance was obtained by means of wireless

and everyone was safely landed. The Lodge-Muirhead patents were acquired by the Marconi Company, and Sir Oliver Lodge became a scientific adviser to the company.

The Marconi Company secured important interests in the Russian Company of Wireless Telegraphs and Telephones.

1912.

This, the last completed year of wireless telegraphy, has perhaps witnessed its greatest development and activity. Early in the year, owing to the improved position of the Marconi Wireless Telegraph Company of America, through the transfer to it of the United Wireless Company's business, further capital was subscribed by the shareholders, sufficient to develop its projects for the erection of long-distance stations throughout the United States and elsewhere.

On January 27th the Aranjuez (Madrid), the central station of the Spanish wireless service, was opened by King Alfonso. Stations at Vigo and Soller were also opened during the year.

In February the Marconi Company secured the important patents of Bellini and Tosi, including those for the wireless compass, and Mr. Bellini's services were secured on the staff of the company.

The disastrous loss of life occasioned by the wreck of the *Titanic* on April 15th was mitigated to some extent through the help secured by its wireless call, and, where all on board might have been drowned but for the assistance of wireless telegraphy, a considerable number of lives were saved.

Mr. Marconi, whilst in America, delivered an address on the "Progress of Wireless Telegraphy" before the New York Electrical Society on April 17th.

Owing to the rapid development of its business, Marconi's Wireless Telegraph Company transferred its offices in May to Marconi House, Strand, and larger works were built at Chelmsford.

The International Radiotelegraphic Conference, opened in London on June 4th, approved important regulations to secure uniformity of practice in Wireless Telegraphic Services.

The British Government entered into a contract in July with the Marconi Company for the erection of a chain of High-Power Wireless Telegraphic Stations, as recommended at the Imperial Conference held in 1911. When the contract was submitted for the ratification of the House of Commons it was referred to a

Select Committee to report thereon. After prolonged sittings no decision has yet been arrived at.

In July the Bolivian Government arranged with the Marconi Company for the erection of two 10 kw. stations at La Paz and Puerto Saurez and 5 kw. stations at Riberalta or Villa Bella, Cobija, Trinidad, Yacuiba, and Santa Cruz. The Canadian Marconi Company was entrusted by the Dominion Government on September 17th with the working of the existing stations on the Great Lakes until 1931 and the erection of further stations. A similar arrangement was come to in December with the Newfoundland Government for stations at Belle Isle and on the Labrador coast.

On September 26th a regrettable accident befel Mr. Marconi whilst travelling by motor-car in Italy, with serious consequences to the great inventor's eyesight.

In September the Norwegian Government entered into a contract with the Marconi Company for the erection of a High-Power Station in Norway to communicate with a station to be erected by the Marconi Company at New York.

On November 12th assistance was called by wireless for the Pacific Steam Navigation Company's s.s. *Oravia*, on a rock off the Falkland Islands, and passengers and mails were saved before the vessel was lost.

On November 13th the patent actions at issue between the Marconi and Telefunken Wireless Companies were mutually settled.

The Marconi Company entered into arrangements for the erection of a High-Power Station at Buenos Aires to communicate with Europe.

Mr. Marconi was decorated with the Grand Cross of the Order of Alfonso XII., and made a Grand Officer of the Order of St. Maurice and Lazarus. In December an important contract was made by the Portuguese Government for the erection of Marconi Stations at Lisbon, Oporto, Azores, Madeira, and the Cape Verde Islands.

WIRELESS TELEGRAPH LAWS AND REGULATIONS

AND THE

INTERNATIONAL CONVENTION

London, 1912

THE development of wireless telegraphy has rendered legislation on the subject essential. There are comparatively few, however, who could realise the extent of this legislation, and the compilation of the laws and regulations of the various countries which appears in the following pages will doubtless occasion not a little surprise.

The movement in favour of wireless telegraph legislation may be said to date back to 1903, although prior to that, in 1899, the Marconi system had then reached a point of development when the Admiralty thought it desirable to obtain sets of the apparatus for trial, and two years later an agreement of a limited character was entered into between the Admiralty and the company for the supply of Marconi apparatus for naval use. In July, 1903, a further and more complete agreement was entered into. At that time the increasing use of wireless telegraphy for maritime purposes had raised questions of international interest, and it had become evident that on many points regarding the interchange of messages international agreement would be desirable.

A conference met at Berlin in August, 1903, on the invitation of the German Government. The outcome of that conference was that all the Powers, with the exception of Great Britain and Italy, agreed to certain proposals to be considered at a subsequent conference for the international regulation of wireless telegraphy. The British delegates had been instructed to maintain an attitude of reserve owing to the position in which wireless telegraphy was at that time placed in the United Kingdom, the fact being that in the then state of the law the Government had not that control over wireless telegraphy which would have enabled them to enforce the provisions of the Convention. The Wireless Telegraphy Act, which was passed in 1904 for two years only, and which was

renewed in 1906 without modification (and is still in force), prohibits the installation or working of wireless telegraphy apparatus in the United Kingdom, on board British ships, without a licence from the Postmaster-General. Its principal objects were, by regulating wireless telegraphy, to make it more useful for purposes of defence and general communication. The memorandum which was laid before the House of Commons in explanation of the Bill stated that the necessity of legislation depended in the first place on the importance from the naval point of view of giving the Government control over wireless stations in time of war or emergency, and, secondly, on the desirability of placing the Government in the position to enter into an agreement on the subject with other countries if it should be found expedient to do so.

In October, 1906, a second conference was held in Berlin, and its primary objects may be classified under the following headings:—

1. The acceptance and transmission of telegrams.

2. The adoption of rules of working.

3. The provision of means of collecting charges and settling accounts between the different countries.

4. Arrangements for the publication of all information necessary for inter-communication.

5. Rules to prevent interference and confusion in working, with adequate provisions for enforcement.

6. Provision that, with certain exceptions, inter-communication must not be refused on account of the differences in the systems of wireless telegraphy employed.

The documents signed at Berlin on November 3rd, 1906, consisted of:—(*a*) The Convention; (*b*) the Additional Undertaking; (*c*) the Final Protocol; (*d*) the Service Regulations. These documents were revised at the London Conference held in 1912, and the Convention, which comes into operation on July 1st, 1913, is set out in the following pages. About 40 per cent. of the delegates present at the last conference were administrative, executive, or technical officials acting for the postal, telegraph, and cable departments of the various countries represented. About another third of the assembly (37 per cent.) were composed of army and navy officers, the relative ratio of naval and military

officers being about 4 to 3. About 6 per cent. of the delegates were trained and experienced diplomats, and the remainder included eminent scientists, noted meteorologists, and prominent personages interested in the technical, commercial, and humanitarian development of wireless telegraphy. Sir Henry Babington Smith presided.

In all, about 350 amendments, additions, and proposals were considered in some form by the conference. About 100 of these proposals were accepted in full or in part, the majority of the amendments adopted, however, being of a minor nature.

The central agency which has been established for the purpose of collecting and distributing information in accordance with the requirements of the Convention is commonly known as the "Berne Bureau." This is merely a branch of the Bureau of the International Telegraph Union, situated at Berne, in Switzerland. It has no initiative or executive power and holds a subordinate position, its functions being practically confined to the collection and circulation of information. Notwithstanding this, the International Bureau at Berne is an organisation of the highest importance, thanks to the zealous, economical and efficient manner in which it is conducted. To this organisation is entrusted the work of preparing and circulating, in accordance with Article 13 of the Convention, particulars regarding each station, such as the name, nationality, geographical position, call signal, normal range, wave length, nature of service performed by the station, hourse of service, etc.

The supplementary expenses resulting from the work of the International Bureau in connection with radiotelegraphy must not exceed 80,000 francs per annum, not including special expenses to which the meeting of an International Conference gives rise. For the purposes of contribution towards the expenses the administrations of the contracting States are divided into six classes, as shown in Article 43 of the regulations.

THE INTERNATIONAL CONVENTION

London, July 5th, 1912

International Radiotelegraph Convention concluded between Great Britain and various British Colonies and Protectorates, the Union of South Africa, the Commonwealth of Australia, Canada, British India, New Zealand, Greece, Italy and the Italian Colonies, Germany and the German Protectorates, the United States of America and the Possessions of the United States of America, the Argentine Republic, Austria, Hungary, Bosnia-Herzegovina, Belgian Congo, Brazil, Bulgaria, Chili, Denmark, France and Algeria, French West Africa, French Equatorial Africa, Indo-China, Madagascar, Tunis, Japan and Chosen, Formosa, Japanese Sakhalin and the Leased Territory of Kwantoung, Morocco, Monaco, Norway, the Netherlands, the Dutch Indies and the Colony of Curacoa, Persia, Portugal and the Portuguese Colonies, Roumania, Russia and the Russian Possessions and Protectorates, the Republic of San Marino, Siam, Sweden, Turkey and Uruguay.

The undersigned Plenipotentiaries of the Governments of the countries enumerated above, being assembled in Conference at London, have, by common consent, and subject to ratification, concluded the following Convention :—

ARTICLE 1.

The High Contracting Parties undertake to apply the provisions of the present Convention in all the radiotelegraph stations (coast stations and ship stations) which are established or worked by the Contracting Parties and open for the service of public correspondence between the land and ships at sea.

They undertake, moreover, to impose the observance of these provisions upon private enterprises authorised either to establish or to work radiotelegraph coast stations open to the service of public correspondence between the land and ships at sea, or to establish or work radiotelegraph stations whether open for public correspondence or not on board the ships which carry their flag.

Article 2.

That which is called a coast station is any radiotelegraph station established on dry land or on board any ship permanently anchored and utilised for the exchange of correspondence with ships at sea.

Any radiotelegraph station established on board a ship other than a permanently stationary ship is called a ship station.

Article 3.

Coast stations and ship stations are bound to exchange radiotelegrams reciprocally without distinction as to the radiotelegraph system adopted by such stations.

Each ship station is bound to exchange radiotelegrams with any other ship station without distinction as to radiotelegraphic system adopted by such stations.

Nevertheless, in order not to impede scientific progress, the provisions of the present Article do not prevent the contingent employment of a radiotelegraphic system incapable of communicating with other systems, provided that such incapacity be due to the specific nature of such system and that it be not the effect of devices adopted solely with the object of preventing intercommunication.

Article 4.

Notwithstanding the provisions of Article 3, a station may be appropriated to a restricted public service determined by the object of the correspondence or by other circumstances independent of the system employed.

Article 5.

Each of the High Contracting Parties undertakes to cause the coast stations to be connected with the telegraph system by means of special wires, or, at any rate, to take such other measures as will ensure a rapid exchange between the coast stations and the telegraphic system.

Article 6.

The High Contracting Parties will mutually notify one another of the names of the coast stations and ship stations covered by Article 1, as well as of all the particulars necessary to facilitate and accelerate the radiotelegraphic exchanges which will be specified in the Detailed Regulations.

Article 7.

Each of the High Contracting Parties reserves to itself the right to prescribe or to permit in the stations covered by

Article 1, independently of the installation of which the particulars are published conformable to Article 6, the installation and working of other devices with a view to a special radiotelegraphic transmission without publication of the details of such devices.

Article 8.

The working of radiotelegraph stations shall be organised as far as possible in such a manner as not to disturb the service of other stations of the kind.

Article 9.

Radiotelegraph stations shall be obliged to accept with absolute priority calls of distress whencesoever they may come, to reply in like manner to such calls, and to give the effect to them which they require.

Article 10.

The charge of a radiotelegram shall include, as the case may be :—

1st. (*a*) The "coast charge" which belongs to the coast station.
(*b*) The "ship charge" which belongs to the ship station.

2nd. The charge for transmission over the lines of the telegraph system, calculated in accordance with the ordinary rules.

3rd. The transit charges of the intermediate coast and ship stations and the charges appertaining to special services required by the sender.

The rate of the coast charge shall be subject to the approval of the Government to which the coast station is subject; that of the ship charge, to the approval of the Government to which the ship is subject.

Article 11.

The provisions of the present Convention are completed by Detailed Regulations which have the same validity and come into force at the same time as the Convention.

The provisions of the present Convention and of the Regulations relating thereto may be modified at any time by common consent of the High Contracting Parties. Conferences of Plenipotentiaries having power to modify the Convention and the Regulations shall take place periodically; each Conference shall itself fix the place and time of the succeeding meeting.

ARTICLE 12.

These Conferences shall be composed of Delegates of the Governments of the Contracting Countries.

In the deliberations each country shall exercise one vote only.

If a Government adhere to the Convention for its colonies, possessions or protectorates, subsequent Conferences may decide that the whole or part of such colonies, possessions or protectorates is to be regarded as forming a country for the purposes of the foregoing clauses. Nevertheless, the number of votes to be exercised by a Government, including its colonies, possessions or protectorates, may not exceed six.

The following are regarded as forming a single country for the purposes of the present Article :—

The Union of South Africa.
The Australian Commonwealth.
Canada.
British India.
New Zealand.
German East Africa.
German South-West Africa.
The Cameroons.
Togo.
The German Pacific Protectorates.
Alaska.
Hawaii and the other American possessions in Polynesia.
The Philippine Islands.
Porto Rico and the American possessions in the Antilles.
The zone of the Panama Canal.
The Belgian Congo.
The Spanish Colony of the Gulf of Guinea.
French West Africa.
French Equatorial Africa.
Indo-China.
Madagascar.
Tunis.
Erithrea.
Italian Somaliland.
Chosen, Formosa, Japanese Sakhalin and the leased territory of Kwantoung.
The Dutch Indies.
The Colony of Curaçao.
Portuguese West Africa.

Portuguese East Africa and the Portuguese possessions in Asia.
Russian Central Asia (littoral of the Caspian Sea).
Bokhara.
Khiva.
Western Siberia (littoral of the Arctic Ocean).
Eastern Siberia (littoral of the Pacific Ocean).

ARTICLE 13.

The International Bureau of the Telegraph Union shall be entrusted with the duty of collecting, co-ordinating, and publishing information of every kind relating to radiotelegraphy, of investigating requests for modification of the Convention, and of the Regulations of Publishing the changes adopted, and, in general, of proceeding to any Administrative work which it may be called upon to undertake in the interests of International Radiotelegraphy.

The expenses of this institution shall be borne by all the Contracting Parties.

ARTICLE 14.

Each of the High Contracting Parties reserves to itself the right to fix the conditions under which it will allow radiotelegrams coming from or destined for a station, whether a ship station or a coast station, which is not subject to the provisions of the present Convention.

If a radiotelegram is admitted, the ordinary charges must be applied to it.

Every radiotelegram which comes from a ship station and is received by a coast station of the contracting country, or accepted in transit by the Administration of a contracting country, shall be sent forward.

Every radiotelegram intended for a ship shall also be sent forward if the Administration of the contracting country has allowed it to be handed in, or if the Administration of a contracting Government has accepted it in transit from a non-contracting country, subject to the right of the coast station to refuse transmission to a ship station subject to a non-contracting country.

ARTICLE 15.

The provisions of the Articles 8 and 9 of this Convention are equally applicable to radiotelegraphic installations other than those covered by Article 1.

ARTICLE 16.

The Governments which have not taken part in the present Convention shall be allowed to become party to it at their own request.

Such adherence shall be notified through diplomatic channels to that one of the contracting Governments in whose territory the last Conference was held, and by that Government to the others.

Such adherence shall involve complete acceptance of all the clauses of the present Convention and admission to all the advantages stipulated therein.

The adherence to the Convention of the Government of a country having colonies, possessions, or protectorates shall not carry with it the adherence of the colonies, possessions, or protectorates of such Government, unless a declaration be made to that effect by such Government. These colonies, possessions, or protectorates as a whole, or each one of them separately, may form the subject of a separate adherence or of a separate denunciation under the conditions indicated in the present Article and in Article 22.

ARTICLE 17.

The provisions of Articles 1, 2, 3, 5, 6, 7, 8, 11, 12, and 17, of the International Telegraph Convention of St. Petersburg dated 10/22 July 1875 shall be applicable to International Radiotelegraphy.

ARTICLE 18.

In case of difference of opinion between two or more contracting Governments in respect of the interpretation or the execution either of the present Convention or of the Regulations provided for by Article 11, the question in dispute may, by common consent, be submitted to arbitration. In such cases, each of the Governments concerned shall choose one other not concerned with the question.

The decision of the Arbitrators shall be made by an absolute majority of votes.

In case of an equality of votes, the Arbitrators shall appoint, in order to settle the difficulty, another Contracting Government not concerned in the question in dispute. In default of an agreement with regard to such choice, each Arbitrator shall nominate a Contracting Government not interested in the dispute; and lots shall be drawn as between the Governments proposed. The

drawing of lots shall be the prerogative of the Government in whose territory the International Bureau provided for in Article 13 performs its work.

ARTICLE 19.

The High Contracting Parties undertake to adopt or to propose to their respective legislatures the measures necessary to ensure the execution of the present Convention.

ARTICLE 20.

The High Contracting Parties will communicate to one another such laws as may have been already enacted or which may be about to be so enacted in their countries, relating to the subject of the present Convention.

ARTICLE 21.

The High Contracting Parties preserve their entire liberty with regard to the radiotelegraph installations not covered by Article 1, and notably with regard to naval and military installations, and also to stations carrying out communications between fixed points. All such installations and stations shall remain subject solely to the obligations provided for in Articles 8 and 9 of the present Convention.

Nevertheless when these installations and stations carry out an exchange of maritime public correspondence, they shall conform, in carrying out such service, to the requirements of the Regulations with regard to the method of transmission and accounting.

If, on the other hand, coast stations carry out, at the same time as public correspondence with ships at sea, communications between fixed points, they shall not be subject, in the execution of this latter service, to the provisions of the Convention, except for the observance of Articles 8 and 9 of that Convention.

However, fixed stations which carry out correspondence between land and land must not refuse the exchange of radiotelegrams with another fixed station on account of the system adopted by such station; nevertheless, the liberty of each country shall remain complete in respect of the organisation of the service for correspondence between fixed points and the decision as to the correspondence to be carried out by the stations appropriated to such service.

ARTICLE 22.

The present Convention shall be put into execution from the 1st of July 1913, and shall remain in force for an indeterminable

period and until the expiry of one year from the day upon which it is denounced.

Denunciation shall not take effect except as regards the Government in whose name it is made. So far as the other Contracting Parties are concerned, the Convention shall remain in force.

ARTICLE 23.

The present Convention shall be ratified, and the ratification thereof shall be deposited in London in as short a time as possible.

If one or more of the High Contracting Parties shall not ratify the Convention, it shall not be thereby less valid for the Parties which have ratified it.

In witness whereof the respective Plenipotentiaries have signed the Convention in a single copy, which shall remain deposited in the archives of the British Government, and of which a copy shall be sent to each Party.

London, the 5th of July, 1912.

FINAL PROTOCOL.

At the time of proceeding to the signature of the Convention concluded by the International Radiotelegraph Conference of London, the undersigned Plenipotentiaries have agreed as follows :—

I.

The exact nature of the adherence notified on the part of Bosnia-Herzegovina not being yet determined, it is recognised that a vote is attributed to Bosnia-Herzegovina, a decision at a later date being necessary on the question whether this vote belongs to Bosnia-Herzegovina in virtue of the second paragraph of Article 12 of the Convention, or whether this vote is accorded to it conformably to the provisions of the third paragraph of that Article.

II.

The following declaration is placed on record :—

The Delegation of the United States declares that its Government is under the necessity of abstaining from all action with regard to tariffs, because the transmission of radiotelegrams as well as of telegrams in the United States is undertaken, wholly or in part, by commercial or private companies.

III.

The following declaration was also placed on record :—

The Government of Canada reserves to itself the right to fix

separately, for each of its coast stations, a total sea charge for radiotelegrams originating from North America and intended for any ship whatever, the coast charge amounting to three-fifths and the ship charge to two-fifths of such total charge.

In witness whereof the respective Plenipotentiaries have drawn up the present Final Protocol, which shall have the same force and the same validity as if the provisions thereof had been inserted in the text itself of the Convention to which it belongs, and they have signed it in a single copy which shall remain deposited in the archives of the British Government, and of which a copy shall be sent to each party.

Done at London the 5th of July, 1912.

DETAILED SERVICE REGULATIONS APPENDED TO THE INTERNATIONAL RADIOTELEGRAPH CONVENTION.

Table of Contents.

I.—ORGANISATION OF RADIOTELEGRAPH STATIONS.

Article 1.

The choice of radiotelegraph apparatus and devices to be used by coast stations and ship stations is free. The installation

of these stations must, as far as possible, be in keeping with scientific and technical progress.

ARTICLE 2.

Two wave-lengths, one of 600 and the other of 300 metres, shall be allowed for the service of general public correspondence. Every coast station open to this service must be equipped in such a way as to be able to use these two wave-lengths, of which one shall be indicated as the normal wave-length of the station. During the whole time that it is open every coast station must be in a condition to receive calls made by means of its normal wave-length. Nevertheless, for the correspondence covered by paragraph 2 of Article 35, use shall be made of a wave-length of 1,800 metres. Further, each Government may authorise the use, in a coast station, of other wave-lengths for the purpose of securing a long-range service or a service other than that of general public correspondence, and established in conformity with the provisions of the Convention, with the reservation that these wave-lengths do not exceed 600 metres, or that they do exceed 1,600 metres.

In particular, stations used exclusively for the despatch of signals intended to determine the position of ships must not use wave-lengths exceeding 150 metres.

ARTICLE 3.

1. Every ship station must be equipped in such a way as to be able to use the wave-lengths of 600 metres and of 300 metres. The first shall be the normal wave-length, and may not be exceeded in transmission, the case of Article 35 (paragraph 2) excepted.

Use may be made of other wave-lengths not exceeding 600 metres in special cases, and subject to the approval of the Administrations to which the coast stations and ship stations concerned are subject.

2. During the whole time that it is open every ship station must be able to receive calls made by means of its normal wave-length.

3. Ships of small tonnage, in the case of which it would be materially impossible to use the wave-length of 600 metres for transmission, may be authorised to employ exclusively the wave-length of 300 metres; they must be able to receive by means of the wave-length of 600 metres.

Article 4.

Communications between a coast station and a ship station, or between two ship stations, must be exchanged on both sides by means of the same wave-length. If, in a particular case, communication is difficult, the two stations may, by mutual consent, pass from the wave-length by means of which they are communicating to the other regulation wave-length. Both stations shall resume their normal wave-lengths when the radiotelegraphic exchange is finished.

Article 5.

1. The International Bureau shall draw up, publish and revise periodically an official map showing the coast stations, their normal ranges, the principal lines of navigation, and the time normally taken by ships for the voyage between the various ports of call.

2. It shall draw up and publish a Nomenclature of the radiotelegraph stations covered by Article I of the Convention, and also periodical supplements for additions and modifications. This Nomenclature shall give, in the case of each station, the following information :—

1st.—For coast stations: the name, nationality, and geographical position indicated by the territorial sub-division and by the longitude and latitude of the place; for ship stations : the name and nationality of the ships; when the case arises, the name and address of the contractor.

2nd.—The call signal. (The call signals must be differentiated from one another, and each one must consist of a group of three letters.)

3rd.—The normal range.

4th.—The radiotelegraphic system with the characteristics of the system of emission (musical sparks, tonality expressed by the number of double vibrations, etc.).

5th.—The wave-lengths used (the normal wave-length to be underlined).

6th.—The nature of the services performed.

7th.—The hours of working.

8th.—When necessary the hour and method of despatch of time signals and meteorological telegrams.

9th.—The coast or ship charge.

3. There shall also be included in the Nomenclature such information relating to radiotelegraph stations other than those

covered by Article 1 of the Convention, as shall be communicated to the International Bureau by the Administrations to which such stations are subject, provided that these are either Administrations which are parties to the Convention, or, if they are not parties to it, have made the declaration provided for in Article 48.

4. The following notations shall be adopted in documents for the use of the international service to designate radiotelegraph stations :—

PG—station open to general public correspondence.
PR—station open to restricted public correspondence.
P—private station.
O—station open only to official correspondence.
N—station always open.
X—station not having fixed working hours.

5. The name of a ship station indicated in the first column of the Nomenclature must be followed, when there is duplication of the name, by the call-signal of such station.

ARTICLE 6.

The exchange of unnecessary signals and words is forbidden to the stations covered by Article 1 of the Convention. Experiments and practice shall not be allowed in these stations, except so far as they do not disturb the service of other stations.

Practice must be carried out with wave-lengths different from those allowed for public correspondence, and with the minimum of power necessary.

ARTICLE 7.

1. All stations are bound to exchange traffic with the minimum of energy necessary to ensure good communication.

2. Every coast and ship station must satisfy the following conditions :—

(*a*) The waves emitted must be as pure and as little damped as possible.

In particular, the use of transmitting devices in which the production of the waves emitted is obtained by discharging the aerial directly by sparks (plain aerial) shall not be allowed except in cases of distress.

It may, however, be allowed in the case of certain special stations (for example those of small boats) in which the primary power does not exceed 50 watts.

(*b*) The apparatus must be capable of transmitting and

receiving at a speed at least equal to 20 words per minute, the word being reckoned at the rate of five letters.

New installations bringing into play an energy of more than 50 watts shall be equipped in such a way that it may be possible to obtain easily several ranges less than the normal range, the shortest being of approximately 15 nautical miles. Installations already established bringing into play an energy of more than 50 watts shall be transformed as far as possible in such a manner as to satisfy the foregoing requirements.

(c) Receiving apparatus must allow of receiving, with the greatest possible amount of protection from disturbance, transmissions made with the wave-lengths specified in present Regulations, up to 600 metres.

3. Stations serving solely for determining the position of ships (*radiophares*) must not operate over an area of greater radius than 30 nautical miles.

Article 8.

Independently of the general conditions specified in Article 7, ship stations must also satisfy the following conditions:—

(a) The power transmitted to the radiotelegraphic apparatus, measured at the terminals of the generator of the station, must not under normal circumstances exceed one kilowatt.

(b) Subject to the provisions of Article 35, paragraph 2, a power exceeding one kilowatt may be used, if the ship is under the necessity of corresponding at a distance of more than 200 nautical miles from the nearest coast station, or if, in consequence of exceptional circumstances, communication cannot be realised except by means of an increase of power.

Article 9.

1. No ship station may be established or worked by private enterprise without a licence issued by the Government to which the ship is subject.

Stations on board ship having their port of register in a colony, possession, or protectorate may be described as being subject to the authority of such colony, possession, or protectorate.

2. Every ship station holding a licence issued by one of the contracting Governments must be regarded by the other Governments as having an installation fulfilling the conditions imposed by the present Regulations.

The competent authorities of the countries where the ship calls may demand the production of the licence. In default of such production, these authorities may ascertain whether the radiotelegraph installations of the ship satisfy the conditions imposed by the present Regulations.

When an Administration has practical evidence that a ship station is not fulfilling these conditions, it must, in every case, address a complaint to the Administration of the country to which the ship is subject. From that point onwards the procedure shall be, when necessary, as provided in Article 12, paragraph 2.

ARTICLE 10.

1. The service of the ship station must be carried out by a telegraphist holding a certificate issued by the Government to which the ship is subject, or, in an emergency and for one voyage only, by another Government party to the convention.

2. There shall be two classes of certificates:

The first-class certificate shall state the professional qualifications of the operator with regard to:—

(*a*) the adjustment of the apparatus and knowledge of their working;

(*b*) transmitting and receiving by ear, at a speed which must not be less than 20 words per minute.

(*c*) knowledge of the regulations applying to the exchange of radiotelegraphic communications.

The second-class certificate may be issued to a telegraphist who only attains to a speed in transmitting and receiving of 12 to 19 words per minute, but who fulfils the other conditions mentioned above. Telegraphists holding a second-class certificate may be allowed:—

(*a*) on ships only using radiotelegraphy for their own service and for the correspondence of the ship's company, in particular on fishing vessels;

(*b*) on all ships as substitutes, provided that such ships have on board at least one operator holding a first-class certificate. Nevertheless, on ships placed in the first class indicated in Article 13, the service must be carried

out by at least two telegraphists holding first-class certificates.

In ship stations, transmissions may only be made by a telegraphist holding a first or second-class certificate, an exception being made of cases of emergency, in which it would be impossible to conform to this provision.

3. Further, the certificate shall testify that the Government has placed the telegraphist under the obligation of preserving the secrecy of correspondence.

4. The radiotelegraph service of the ship station shall be placed under the supreme authority of the captain of the ship.

Article 11.

Ships provided with radiotelegraph installations and placed in the first two classes indicated in Article 13 shall be bound to have emergency radiotelegraph installations of which all the parts shall be placed in conditions of the greatest safety possible, such conditions to be determined by the Government which issues the licence. These emergency installations must have at command a source of power of their own, must be capable of being set working speedily, must be able to work for six hours at least, and must have a minimum range of 80 nautical miles in the case of ships in the first class, and of 50 miles in the case of those of the second class. This emergency installation shall not be required in the case of ships whose ordinary installation fulfils the conditions of the present article.

Article 12.

1. If an Administration has information of a breach of the Convention or of the Regulations committed in one of the stations which it has authorised, it shall ascertain the facts and fix the responsibility.

In the case of ship stations, if the responsibility rests on the operator, the Administration shall take the necessary steps, and, if necessary, shall withdraw the certificate. If it is shown that the breach was due to the condition of the apparatus or to instructions given to the telegraphist, the same procedure shall be followed in respect of the licence issued to the ship.

2. In the event of repeated breaches by the same ship, if the representations made to the Administration to which the ship is subject, by another Administration, remain without effect, the latter shall have the right, after notice given, of authorising its coast stations not to accept communications coming from the ship

in question. In case of a difference between the two Administrations, the question shall be submitted to Arbitration on the request of one of the Governments concerned. The procedure is indicated in Article 18 of the Convention.

II.—HOURS OF SERVICE OF STATIONS.

Article 13.

(a) *Coast Stations.*

1. The service of coast stations shall be, as far as possible, permanent, day and night, without interruptions.

Nevertheless certain coast stations may have a service of limited duration. Each Administration shall fix the hours of service.

2. Coast stations whose service is not permanent may not close before having transmitted all their radiotelegrams to the ships which are in their radius of action nor before having received from such ships all the radiotelegrams of which notice has been given. This provision shall also apply when ships notify their presence before work has actually ceased.

(b) *Ship Stations.*

3. Ship stations shall be placed in three classes :—

   1st, stations always open;

   2nd, stations having limited working hours;

   3rd, stations having no fixed working hours.

During navigation, the following must remain permanently on the watch: 1st, ships of the first class; 2nd, those of the second class, during the hours that they are open for service; out of these hours, the latter stations must remain on the watch for the first 10 minutes of each hour. The stations of the third class are not bound to perform any regular "listening" service.

It shall fall to the Governments which issue the licences specified in Article 9 to fix the class in which the ship is to be placed, in respect of its obligations in the matter of keeping watch. This classification shall be mentioned in the licence.

III.—DRAWING UP AND HANDING IN OF RADIOTELEGRAMS.

Article 14.

1. Radiotelegrams shall bear, as the first word of the preamble, the service instructions "radio."

2. In the transmission of radiotelegrams coming from a ship

at sea, the date and the hour of the handing in at the ship station shall be indicated in the preamble.

3. On forwarding over the telegraph system, the coast station shall insert, as the indication of the office of origin, the name of the ship of origin as it appears in the Nomenclature, and also, when the case arises, that of the last ship which served as an intermediary. These particulars shall be followed by the name of the coast station.

Article 15.

1. The address of radiotelegrams intended for ships must be as complete as possible. It shall be compulsorily drawn up as follows :—

(*a*) Name or title of the addressee, with supplementary particulars if necessary.

(*b*) Name of the ship, as it appears in the first column of the Nomenclature.

(*c*) Name of the coast station, as it appears in the Nomenclature.

Nevertheless the name of the ship may be replaced, at the risks and perils of the sender, by the particulars of the voyage taken by such ship and determined by the names of the ports of origin and destination or by any other equivalent particulars.

2. In the address, the name of the ship, as it appears in the first column of the Nomenclature, shall be counted in every case, and independently of its length, as one word.

3. Radiotelegrams drawn up by means of the International Signal Code shall be forwarded to their destination without being de-coded.

IV.—CHARGES.

Article 16.

1. The coast charge and the ship charge shall be fixed in accordance with the tariff per word pure and simple, on the basis of a fair remuneration for radiotelegraphic work, with optional application of a minimum charge per radiotelegram.

The coast charge may not exceed 60 centimes per word, nor the ship charge 40 centimes per word. Nevertheless each Administration shall have the right to authorise coast and ship charges higher than these maxima in the case of stations having a range of more than 400 nautical miles, or if stations exceptionally onerous on account of the material conditions of their installation or working.

The optional minimum charge per radiotelegram may not exceed the coast or ship charge for a radiotelegram of 10 words.

2. In the case of radiotelegrams originating from or intended for a country and exchanged directly with the coast stations of that country, the charge applying to the transmission over the lines of the telegraph system must not exceed, on the average, that of the inland rate of that country.

This charge shall be reckoned per word pure and simple, with an optional minimum charge not exceeding the charge for 10 words. It shall be notified in francs by the Administration of the country to which the coast station is subject.

In the cases of countries in the European system, with the exception of Russia and Turkey, there shall only be a single charge for the territory of each country.

ARTICLE 17.

1. When a radiotelegram originating from a ship and intended for *terra firma* passes through one or two ship stations, the charge shall include, in addition to those of the ship of origin, the coast station, and the telegraph system, the ship charge of each of the ships taking part in the transmission.

2. The sender of a radiotelegram originating from *terra firma* and intended for a ship may require that his message be transmitted by way of one or two ship stations; he shall deposit for this purpose the amount of the radiotelegraphic and telegraphic charges, and besides, as a deposit, a sum to be fixed by the office of origin with a view to the payment to the intermediate ship stations of the transit charges fixed in paragraph 1; he must further pay, as he may choose, either the charge for a telegram of five words or the cost of postage of a letter to be sent by the coast station to the office of origin giving the information necessary for the liquidation of the sum deposited.

The radiotelegram shall then be accepted at the risks and perils of the sender; it shall bear before the address the paid additional particulars "x retransmissions telegraphe" or "x retransmissions lettre" (x representing the number of retransmissions required by the sender) accordingly as the sender desires that the information necessary for the liquidation of the deposit be furnished by telegram or by letter.

3. The charge for radiotelegrams originating from a ship, intended for another ship, and sent by way of one or two intermediate coast stations, shall include:—

The ship charges of both ships, the charge of the coast

station or the two coast stations, as the case may be, and when necessary the telegraph charge appropriate to the transit between the two coast stations.

4. The charge for radiotelegrams exchanged between ships without the aid of a coast station includes the ship charges of the ship of origin and of the ship of destination, with the ship charges of the intermediate stations added thereto.

5. The coast and ship charges due to the stations of transit shall be the same as those fixed for such stations when these are stations of origin and destination. In no case shall they be collected more than once.

6. In the case of any intermediate coast station, the charge to be collected for the transit service shall be the highest of the coast charges appertaining to the direct exchange with the two ships in question.

Article 18.

The country in whose territory is established a coast station acting as intermediary for the exchange of radiotelegrams between a ship station and another country shall be regarded, for the purpose of applying telegraphic charges, as the country of origin or of destination of such radiotelegrams and not as the country of transit.

V.—COLLECTION OF CHARGES.

Article 19.

1. The total charge for radiotelegrams shall be collected from the sender, with the exception—1st, of the cost of express delivery (Article 58, paragraph 1, of the Telegraph Regulations); 2nd, of the charges applying to inadmissible joinings or alterations of words noted by the office or station of destination (Article 19, paragraph 9, of the Telegraph Regulations), these charges being collected from the addressee.

Ship stations must possess the necessary tariffs for this purpose. They shall have, however, the right to obtain information from coast stations with regard to charges for radiotelegrams for which they do not possess all the necessary information.

2. The counting of words by the office of origin shall be decisive in the case of radiotelegrams addressed to ships, and that of the ship station of origin shall be decisive in the case of radiotelegrams originating in ships, both for the purpose of transmission and for that of the international accounts. Nevertheless when the radiotelegram is worded wholly or in part either

Sir H. Babington Smith
(Chairman, International Radiotelegraphic Conference, London, 1912).

[To face page 69

in one of the languages of the country of destination, in the case of radiotelegrams originating in ships, or in one of the languages of the country to which the ship belongs, in the case of radiotelegrams addressed to ships, and when the radiotelegram contains joinings or alterations of words contrary to the common use of that language, the office or ship station of destination, as the case may be, shall have the right to recover from the addressee the amount of the charge not collected. In the case of a refusal to pay the radiotelegram may be withheld.

VI.—TRANSMISSION OF RADIOTELEGRAMS.

(a) *Signals of Transmission.*

ARTICLE 20.

The signals employed shall be those of the International Morse Code.

ARTICLE 21.

Ships in distress shall make use of the following signal,

. . . — — — . . .

repeated at short intervals, followed by the necessary particulars.

As soon as a station hears the signal of distress, it must suspend all correspondence and must not resume the same until after it has made sure that the communication consequent upon the call for help is finished.

The stations which hear a call of distress must act according to indications given by the ship which makes the call, with regard to the order of messages or their cessation.

When, at the end of a series of distress calls, there is added the call signal of the particular station, the reply to the call is proper to that station only, unless that station does not reply. Failing the indication of a particular station in the call for help, every station that hears the call shall be bound to reply thereto.

ARTICLE 22.

For the purpose of giving or asking information concerning the radiotelegraph service, stations must make use of the signals contained in the list appended to the present Regulations. (See p. 76.)

(b) *Order of Transmission.*

ARTICLE 23.

Between two stations, radiotelegrams of the same class shall be transmitted singly in alternate order or by series of several radiotelegrams, according to the instructions given by the coast

station, on condition that the duration of the transmission of each series do not exceed 15 minutes.

(c) *Calling of Stations and Transmission of Radiotelegrams.*

ARTICLE 24.

1. As a general rule, it shall be the ship station that calls the coast station, whether it has radiotelegrams to transmit or not.

2. In waters where the radiotelegraphic traffic is congested (the Channel, etc.), the call of a ship to a coast station may not, as a general rule, be made unless the latter is within the normal range of the ship station and the ship station has approached to a distance less than 75 per cent. of the normal range of the coast station.

3. Before proceeding to make a call, the coast station or the ship station must adjust its receiving system to the highest possible degree of sensitiveness, and must make sure that no other communication is being made within its radius of action; if it is otherwise, it shall await the first break, unless it finds that its call is not likely to disturb the communication in progress. The same applies when the station wishes to answer a call.

4. For making a call, every station shall use the normal wave of the station to be called.

5. If, in spite of these precautions, a radiotelegraphic transmission be impeded, the call must cease on the first request made by a coast station open to public correspondence. This station must then indicate the approximate duration of the wait.

6. The ship station must make known to each coast station to which it has notified its presence the time at which it proposes to cease its operations, and also the probable duration of the interruption.

ARTICLE 25.

1. The call comprises the signal — . — . —, the call signal of the station called, sent three times, and the word "de," followed by the call signal of the sending station, sent three times.

2. The station called shall reply by giving the signal — . — . —, followed by the call signal, sent three times, of the calling station, by the word "de" its own call signal and the signal — . —

3. Stations which wish to enter into communication with ships, without, however, knowing the names of those ships which are within their radius of action, may use the signal

— . — . — — . — (signal of enquiry). The provisions of paragraphs 1 and 2 are also applicable to the transmission of the signal of enquiry and to the reply to that signal.

ARTICLE 26.

If a station when called does not reply when the call (Article 25) has been sent three times at intervals of 2 minutes, the call may not be resumed until after an interval of 15 minutes, the station making the call first making sure of the fact that no radiotelegraphic communication is in progress.

ARTICLE 27.

Every station which has to make a transmission necessitating the use of high power shall first send out three times the warning signal — — . . — —, with the minimum of power necessary to reach the neighbouring stations. It shall not then begin to transmit with the high power until 30 seconds after sending the warning signal.

ARTICLE 28.

1. As soon as the coast station has replied, the ship station shall furnish it with the following information if it has messages to transmit to it; this information shall also be given when the coast stations ask for it :—

(*a*) The approximate distance, in nautical miles, of the vessel from the coast station;

(*b*) The position of the ship given in a concise form and adapted to the circumstances of the individual case;

(*c*) The next port at which the ship will touch;

(*d*) The number of radiotelegrams if they are of normal length or the number of words if the messages are of exceptional length.

The speed of the ship in nautical miles shall be given specially at the express request of the coast station.

2. The coast station shall reply giving, as provided in paragraph 1, either the number of telegrams or the number of words to be transmitted to the ship and also the order of transmission.

3. If transmission cannot take place immediately the coast station shall inform the ship station of the approximate length of the wait.

4. If a ship station when called cannot receive for the moment it shall inform the calling station of the approximate length of the wait.

5. In the case of exchanges between two ship stations it shall rest with the station called to fix the order of transmission.

ARTICLE 29.

When a coast station is called by several ship stations, it shall decide the order in which these stations shall be allowed to exchange their messages.

In the regulation of this order, the coast station shall be guided solely by the necessity for allowing every station concerned to exchange the greatest possible number of radiotelegrams.

ARTICLE 30.

Before beginning to exchange correspondence, the coast station shall inform the ship station whether the transmission is to be made in alternate order by series (Article 23); it shall then begin to transmit, or shall follow up these instructions by the signal — . —

ARTICLE 31.

The transmission of a radiotelegram shall be preceded by the signal — . — . — and ended by the signal . — . — . followed by the call signal of the sending station and by the signal — . —

In the case of a series of radiotelegrams, the call-letter of the sending station and the signal — . — shall only be given at the end of the series.

ARTICLE 32.

When the radiotelegram to be transmitted contains more than 40 words, the sending station shall interrupt the transmission by the signal . . — — . . after each series of 20 words or thereabouts, and it shall not resume transmission until after having obtained from the station in correspondence the repetition of the last word clearly received, followed by the said signal, or, if the reception is clear, the signal — . —

In the case of transmission in series, the acknowledgment of receipt shall be given after each radiotelegram.

Coast stations engaged in transmitting long radiotelegrams must suspend transmission at the end of each period of 15 minutes, and must remain silent during a period of 3 minutes before continuing transmission.

Coast and ship stations which work in the conditions laid down in Article 35, paragraph 2, must suspend work at the end of each period of 15 minutes, and keep watch on the wave-length

of 600 metres during a period of 3 minutes before continuing transmission.

ARTICLE 33.

1. When the signals become doubtful, all possible resources must be drawn upon to accomplish transmission. To this end, the radiotelegram shall be transmitted three times at most, at the request of the receiving station. If in spite of this triple transmission the signals are still unintelligible, the radiotelegram shall be cancelled.

If the acknowledgment of receipt does not come to hand, the sending station shall again call the station with which it is in correspondence. When no reply is made after three calls, the transmission shall not be persevered with. In such case, the sending station shall have the right to obtain the acknowledgment of receipt through the medium of another radiotelegraph station, using, when necessary, the lines of the telegraph system.

2. If the receiving station considers that, in spite of defective receiving, the radiotelegram can be delivered, it shall insert at the end of the preamble the service advice "Reception douteuse" and shall forward the radiotelegram. In such case, the Administration to which the coast station is subject shall claim the charges, in conformity with Article 42 of the present Regulations. Nevertheless, if the ship station later on transmits the radiotelegram to another coast station of the same Administration, the latter can only claim the charges appertaining to a single transmission.

(d) *Acknowledgment of Receipt and End of Work.*

ARTICLE 34.

1. The acknowledgment of receipt shall be given in the form prescribed by the International Telegraph Regulations; it shall be preceded by the call signal of the sending station and followed by the call signal of the receiving station.

2. The end of the work between two stations shall be indicated by each one of them by means of the signal . . . — . — followed by its own call signal.

(e) *Route to be taken by Radiotelegrams.*

ARTICLE 35.

1. As a general principle, the ship station shall transmit its radiotelegrams to the nearest coast station.

However, if the ship station has the choice between several coast stations at equal or nearly equal distances, it shall give

the preference to that which is established on the territory of the country of destination or of normal transit of its radiotelegrams.

2. Nevertheless, a sender on board a ship shall have the right to indicate the coast station by which he wishes his radiotelegram to be forwarded. The ship station shall then wait until this coast station is the nearest.

Exceptionally, transmission may be made to a more distant coast station, provided :—

(*a*) that the radiotelegram is intended for the country in which such coast station is situated and that it comes from a ship subject to that country;

(*b*) that for calls and transmission both stations use a wave length of 1,800 metres;

(*c*) that transmission by this wave-length does not disturb any transmission made, by means of the same wave-length, by a nearer coast station;

(*d*) that the ship station is more than 50 nautical miles distant from any coast station shown in the Nomenclature. The distance of 50 miles may be reduced to 25 miles, subject to the reservation that the maximum power at the terminals of the generator do not exceed 5 kilowatts and that the ship stations be established in conformity with Articles 7 and 8. This reduction of distance shall not apply in the seas, bays or gulfs of which the shores belong to one country only and of which the opening to the high sea is less than 100 miles wide.

VII.—DELIVERY OF RADIOTELEGRAMS.

Article 36.

When for any cause whatsoever a radiotelegram coming from a ship at sea and intended for *terra firma* cannot be delivered to the addressee an advice of non-delivery shall be sent out. This advice shall be transmitted to the coast station which received the original radiotelegram. The latter, after verifying the address, shall forward the advice to the ship, if possible, and, if need be, by way of another coast station of the same country or of a neighbouring country.

When a radiotelegram, having arrived at the ship station, cannot be delivered, that station shall inform the office or ship station of origin by means of a service advice. In the case of radiotelegrams coming from *terra firma* this advice shall be trans-

mitted, whenever possible, to the coast station by way of which the radiotelegram passed, or, if necessary, to another coast station of the same country or of a neighbouring country.

ARTICLE 37.

If the ship to which the radiotelegram is addressed has not notified its presence to the coast station within the time specified by the sender, or, in the absence of such specification, up to the morning of the eighth day following, such coast station shall give notice of the fact to the office of origin, which shall inform the sender of the same.

This latter shall have the option of requiring by paid service advice, telegraphic or postal, addressed to the coast station, that his radiotelegram be kept for a fresh period of nine days, for transmission to the ship, and so on. In the absence of such request the radiotelegram shall be returned as undelivered at the end of the ninth day (the day of handing in not to be included).

However, if the coast station is sure that the ship has left its radius of action before the station could have transmitted the radiotelegram to it, such station shall immediately inform the office of origin, which shall without delay advise the sender of the cancellation of the message. Nevertheless, the sender may, by paid service advice, request the coast station to transmit the radiotelegram when the ship next passes.

VIII.—SPECIAL RADIOTELEGRAMS.

ARTICLE 38.

The following only shall be allowed :—

1st, *Reply Paid Radiotelegrams*.—These radiotelegrams shall bear, before the address, the indication, "Réponse payée," or "RP," completed by the mention of the amount paid in advance for the reply—for example : "Réponse payée fr. x," or "RP, fr. x."

The reply voucher issued on board a ship shall give the right to send, up to the limit of its value, a radiotelegram to any address whatever from the ship station which issues such voucher.

2nd, *Collated Radiotelegrams*.

3rd, *Express Delivery Radiotelegrams*.—But only in cases in which the amount of the cost of express delivery is collected from the addressee. The countries which cannot adopt these radiotelegrams must notify the fact to the International Bureau. Radiotelegrams for express delivery, with collection of the cost from the sender, may be allowed when they are intended for the

country in whose territory the corresponding coast station is situated.

4th, *Radiotelegrams for Delivery by Post.*

5th, *Multiple Radiotelegrams.*

6th, *Radiotelegrams with Acknowledgment of Receipt.*—But only with regard to notification of the date and time at which the coast station has transmitted to the ship station the telegram addressed to the latter.

7th, *Paid Service Advices.*—Except those asking for repetition of information. Nevertheless, all paid service advices shall be allowed on the route over the telegraph lines.

8th, *Urgent Radiotelegrams.*—But only in transmission over the telegraph lines, and subject to the application of the International Telegraph Regulations.

ARTICLE 39.

Radiotelegrams may be transmitted by a coast station to a ship, or by a ship to another ship, with the object of being forwarded by post, the posting to take place from a port of call of the receiving ship.

The address of these radiotelegrams must be drawn up as follows :—

1st, Paid instruction "poste," followed by the name of the port where the radiotelegram is to be posted;

2nd, Full name and address of the addressee;

3rd, Name of the ship station which is to carry out the posting;

4th, When necessary, name of the coast station.

Example: Poste Buenos Aires, Martinez, 14 Calle Prat, Valparaiso, Avon Lizard.

The charge shall include, as well as the radiotelegraph and telegraph charges, a sum of 25 centimes for the postage of the radiotelegram.

IX.—ARCHIVES.

ARTICLE 40.

The originals of radiotelegrams, as well as the documents relating thereto, retained by the Administrations, shall be kept with all necessary precautions in respect of secrecy for at least fifteen months, counting from the month following that in which the radiotelegrams were handed in.

These originals and documents shall be sent, as far as

possible, at least once a month by the ship stations to the Administrations to which they are subject.

X.—REFUNDS AND REIMBURSEMENTS.

ARTICLE 41.

With regard to refunds and reimbursements, the provisions of the International Telegraph Regulations shall apply, bearing in mind the restrictions laid down in Articles 38 and 39 of the present Regulations and subject to the following reservations:—

The time occupied in radiotelegraphic transmission, and also the time during which the radiotelegram remains at the coast station in the case of radiotelegrams addressed to ships, or in the ship station in the case of radiotelegrams originating in ships, shall not be counted in the period of delay giving rise to refunds and reimbursements.

If the coast station informs the office of origin that a radiotelegram cannot be transmitted to the ship to which it is addressed, the Administration of the country of origin shall immediately initiate the reimbursement to the sender of the coast and ship charges in respect of such radiotelegram. In this case, the charges reimbursed shall not appear in the account for which provision is made by Article 42, but the radiotelegram shall be mentioned therein as a memorandum.

Reimbursements shall be borne by the various Administrations and private enterprises which have taken part in the forwarding of the radiotelegram, each one of them relinquishing its share of the charge. Nevertheless, radiotelegrams falling under the provision of Articles 7 and 8 of the Convention of St. Petersburg shall remain subject to the provisions of the International Telegraph Regulations, except when it is due to an error of service that such radiotelegrams have been accepted.

When the acknowledgment of receipt of a radiotelegram has not reached the station which transmitted the message, the charge shall not be refunded until it has been proved that the radiotelegram is one which gives occasion for reimbursement.

XI.—ACCOUNTING.

ARTICLE 42.

1. Coast and ship charges shall not be entered in the accounts provided for by the International Telegraph Regulations.

The accounts relating to these charges shall be settled by the Administrations of the countries concerned. They shall be pre-

pared by the Administrations to which the coast stations belong, and communicated by them to the Administrations concerned. In cases in which the working of the coast stations is independent of the Administration of the country, the person working these stations may be substituted in respect of accounts for the Administration of such country.

2. As to transmission over the lines of the telegraph system the radiotelegram shall be treated in respect of accounts in conformity with the Telegraph Regulations.

3. In the case of radiotelegrams originating from ships the Administration to which the coast station is subject shall debit the Administration to which the ship station of origin is subject with the coast and ordinary telegraph charges, the total charges collected for prepaid replies, the coast and telegraph charges collected for collations, the charges appertaining to express delivery (in the case provided for in Article 38) or delivery by post, and with those collected for supplementary copies (TM). The Administration to which the coast station is subject shall credit, when the case arises, through the channel of the telegraph accounts and through the medium of the offices which have taken part in the transmission of the radiotelegrams, the Administration to which the office of destination is subject with the total charges relating to prepaid replies. With regard to telegraph charges and charges relating to express delivery or delivery by post, and to supplementary copies, the procedure shall be in conformity with the telegraph regulations, the coast station being regarded as the telegraph office of origin.

In the case of radiotelegrams intended for a country lying beyond that to which the coast station belongs, the telegraph charges to be liquidated conformably to the above provisions are those which arise either from tables "A" and "B" appended to the International Telegraph Regulations or from special arrangements concluded between the Administrations of adjoining countries, and published by those Administrations, and not the charges which might be made under the special provisions of Articles 23 (paragraph 1) and 27 (paragraph 1) of the Telegraph Regulations.

In the case of radiotelegrams and paid-service advices addressed to ships, the Administration to which the office of origin is subject shall be debited directly by that to which the coast station is subject with the coast and ship charges. Nevertheless, the total charges appertaining to prepaid replies shall be credited,

if there is occasion, from country to country through the channel of the telegraph accounts, until they reach the Administration to which the coast station is subject. In respect of the telegraph charges and charges relating to delivery by post and for supplementary copies, the procedure shall be in conformity with the telegraph regulations. The Administration to which the coast station is subject shall credit that to which the ship of destination is subject with the ship charge, if there is occasion, with the charges belonging to the intermediate ship stations, with the total charge collected for prepaid replies, with the ship charge relating to collation, and also with the charges made for preparing supplementary copies and for delivery by post.

The paid service advices, and the prepaid replies themselves, shall be treated, in the radiotelegraph accounts, in all respects like other radiotelegrams.

In the case of radiotelegrams forwarded by means of one or two intermediate ship stations, each of the latter shall debit the ship station of origin, if the radiotelegram is one coming from a ship, or the ship station of destination if the radiotelegram is one intended for a ship, with the ship charge due to it for transit.

4. In principle the settlement of account appertaining to exchanges between ship stations shall be made directly as between the companies working those stations, the station of origin being debited by the station of destination.

5. The monthly accounts serving as a basis for the special accounting in respect of radiotelegrams shall be drawn up radiotelegram by radiotelegram, with all necessary particulars, and within a period of six months counting from the month to which they belong.

6. The Governments reserve to themselves the option of making between themselves and with private companies (contractors working radiotelegraphic stations, shipping companies, etc.) special arrangements with a view to the adoption of other provisions respecting accounts.

XII.—INTERNATIONAL BUREAU.

Article 43.

The supplementary expenses resulting from the work of the International Bureau in connection with radiotelegraphy must not exceed 80,000 fcs. per annum, not including special expenses to which the meeting of an International Conference gives rise.

The Administrations of the contracting States shall be, for purposes of contribution towards the expenses, divided into six classes as follows:—

1st Class.—Union of South Africa, Germany, United States of America, Alaska, Hawaii, and the other American possessions in Polynesia, the Philippine Islands, Porto Rico and the American possessions in the Antilles, the zone of the Panama Canal, the Argentine Republic, Australia, Austria, Brazil, Canada, France, Great Britain, Hungary, British India, Italy, Japan, New Zealand, Russia, Turkey.

2nd Class.—Spain.

3rd Class.—Russian Central Asia (littoral of the Caspian Sea), Belgium, Chili, Chosen, Formosa, Japanese Sakhalin and the leased territory of Kwantung, Dutch Indies, Norway, Holland, Portugal, Roumania, Western Siberia (littoral of the Arctic Ocean), Eastern Siberia (littoral of the Pacific Ocean), Sweden.

4th Class.—German East Africa, German South-West Africa, The Cameroons, Togo, German Pacific Protectorates, Denmark, Egypt, Indo-China, Mexico, Siam, Uruguay.

5th Class.—French West Africa, Bosnia-Herzegovina, Bulgaria, Greece, Madagascar, Tunis.

6th Class.—French Equatorial Africa, Portuguese West Africa, Portuguese East Africa and the Portuguese possessions in Asia, Bokhara, the Belgian Congo, the Colony of Curaçoa, the Spanish Colony of the Gulf of Guinea, Erithrea, Khiva, Morocco, Monaco, Persia, San Marino, Italian Somaliland.

Article 44.

The various Administrations shall forward to the International Bureau a form modelled on that hereto appended (see pp. 75, 76) and containing the particulars enumerated in the form with regard to the stations covered by Article 5 of the Regulations. Any modifications which may take place and additions shall be communicated by the Administrations to the International Bureau from the 1st to the 10th of each month. With the help of these communications the International Bureau will draw up the Nomenclature provided for by Article 5. The Nomenclature shall be distributed to the Administrations concerned. It may also, with the supplements relating thereto, be sold to the public at cost price.

The International Bureau shall take care that the adoption of identical call signals for radiotelegraph stations be avoided.

XIII. — METEOROLOGICAL TRANSMISSIONS, TIME SIGNALS, AND OTHER TRANSMISSIONS.

Article 45.

1. The Administrations shall take the necessary steps to supply their coast stations with meteorological telegrams containing the particulars of interest to the district of such stations. These telegrams, the text of which must not exceed twenty words, shall be sent to the ships which ask for them. The charge for these meteorological telegrams shall be carried to the account of the ships to which they are addressed.

2. The meteorological observations, made by certain ships appointed for that purpose by the country to which they belong, may be sent once a day as paid service advices to the coast stations authorised to receive them by the Administrations concerned, who shall also appoint the meteorological offices to which these observations shall be addressed by the coast station.

3. Time signals and meteorological telegrams shall be transmitted in succession one to another in such a way that the total duration of their transmission does not exceed ten minutes. In principle while they are being sent all radiotelegraph stations, transmission by which might disturb the reception of these signals and telegrams, shall keep silent, so as to allow all stations which desire to do so to receive these telegrams and signals. An exception shall be made in the case of distress calls and State telegrams.

4. The Administrations shall facilitate the communication to the marine information agencies which they may appoint of the information respecting wrecks and casualties at sea, or presenting a general interest for navigation, which the coast stations can communicate regularly.

XIV.—MISCELLANEOUS PROVISIONS.

Article 46.

Transmission exchanged between ship stations must be carried out in such a way as not to interfere with the service of coast stations, as the latter must have, as a general rule, right of priority for public correspondence.

Article 47.

Coast stations and ship stations shall be bound to take part in the retransmission of radiotelegrams in cases in which com-

munication cannot be established directly between the stations of origin and destination.

Nevertheless, the number of transmissions shall be limited to two.

In the case of radiotelegrams intended for *terra firma* use may only be made of retransmissions to reach the nearest coast station.

Retransmission shall be in all cases subject to the condition that the intermediate station which receives the radiotelegram in transit is in a position to send it on.

Article 48.

If the transmission of a radiotelegram is carried out partly on the telegraph lines or through radiotelegraph stations belonging to a non-contracting Government, such radiotelegram may be sent forward, subject to the reservation that at least the Administrations to which these lines or stations belong shall have declared that they are willing to apply, when the case arises, the provisions of the Convention and of the Regulations, which are indispensable, in order that radiotelegrams may be regularly forwarded, and that accounting may be assured.

Such declaration shall be made to the International Bureau, and brought to the knowledge of the offices of the Telegraph Union.

Article 49.

The modifications of the present Regulations which may be rendered necessary in consequence of the decisions of future Telegraph Conferences shall come into force on the date fixed for the application of the provisions decided upon by each one of these later Conferences.

Article 50.

The provisions of the International Telegraph Regulations shall apply by analogy to radiotelegraph correspondence in so far as they are not contrary to the provisions of the present Regulations.

The following in particular apply to radiotelegraph correspondence :—

The provisions of Article 27, paragraphs 3 to 6, of the Telegraph Regulations referring to the collection of charges; those of Articles 36 and 41 referring to the indication of the route to be taken; those of Articles 75, paragraph 1, 78, paragraphs 2 to 4, and 79, paragraphs 2 to 4, relating to preparing

of accounts. Nevertheless, first, the period of six months provided by paragraph 2 of Article 79 of the Telegraph Regulations for the verification of accounts is extended to nine months in the case of radiotelegrams; second, the provisions of Article 16, paragraph 2, are not considered as authorising the free transmission by radiotelegraph stations of service telegrams relating exclusively to the telegraph service, nor the free transmission over the lines of the telegraph system of service telegrams relating exclusively to the radiotelegraph service; third, the provisions of Article 79, paragraphs 3 and 5, do not apply to radiotelegraph accounting. For the purposes of applying the provisions of the Telegraph Regulations coast stations shall be regarded as offices of transit, except when the Radiotelegraphic Regulations stipulate expressly that these stations are to be considered as offices of origin or destination

Conformable to Article 2 of the Convention of London the present regulations will come into force on the 1st of July, 1913.

In witness whereof the respective Plenipotentiaries have signed these Regulations on a single copy, which will remain deposited in the archives of the British Government, and of which a copy will be sent to each party.

APPENDIX

I.

Tables referred to in Article 44 (p. 72).

(*a*) Coast Stations.

Name.	Nationality.	Geographical Position. E=East longitude; O=West longitude; N=North latitude; S=South latitude. Territorial subdivisions.	Call Signal.	Normal Range in Nautical Miles.	Radiotelegraph System, with the characteristics of the System of emission.	Wave-lengths in metres (the normal wave-length is underlined).

Nature of Services effected.	Working hours (Time according to the Meridian).	Coast Charge.		*Observations* (if occasion, Time and Method of sending Time-Signals and Meteorological Telegrams).
		Per Word in Francs.	Minimum per Radiotelegram in Francs.	

(b) SHIP STATIONS.

Name.	Nationality.	Call Signal.	Normal Range in Nautical Miles.	Radiotelegraph System, with the characteristics of the System of emission.	Wave-lengths in Metres.

Nature of Services effected.	Working Hours.	Ship Charge.		*Observations* (if occasion, Name and Address of the person working the Station).
		Per Word in Francs.	Minimum per Radiotelegram in Francs.	

1° WARSHIPS.

2° MERCHANT SHIPS.

II.

LIST OF ABBREVIATIONS TO BE USED IN RADIOTELEGRAPH TRANSMISSIONS (referred to in Article 22, p. 61).

Abbreviation. 1.	Question. 2.	Answer or Advice. 3.
—.—. ——.— (CQ)	.. .. ..	Inquiry signal employed by a station desires to correspond.
—.—. (TR)	.. ..	Signal announcing the sending of indications concerning a ship station (article....).
——..——(!)	.. ..	Signal indicating that a station is about to send with high power.
PRB	Do you wish to communicate with my station by means of the International Signal Code ?	I wish to communicate with your station by means of International Signal Code.
QRA	What is the name of your station ?	This station is ....
QRB	How far are you from my station ?	The distance between our stations is .... nautical miles.
QRC	What are your true bearings ? ..	My true bearings are .... degrees.
QRD	Where are you bound ?	I am bound for ....
QRF	Where are you coming from ? ..	I am coming from ....
QRG	To what company or line of navigation do you belong ?	I belong to ....
QRH	What is your wave-length ? ..	My wave-length is .... metres.
QRJ	How many words have you to transmit ?	I have .... words to transmit.
QRK	How are you receiving ?	I am receiving well.
QRL	Are you receiving badly ? Shall I transmit 20 times ...—. so that you can adjust your apparatus ?	I am receiving badly. Transmit 20 times ...—. so that I can adjust my apparatus.
QRM	Are you disturbed ?	I am disturbed.
QRN	Are the atmospherics very strong	The atmospherics are very strong.
QRO	Shall I increase my power ? ..	Increase your power.
QRP	Shall I decrease my power ? ..	Decrease your power.
QRQ	Shall I transmit faster ?	Transmit faster.
QRS	Shall I transmit more slowly ? ..	Transmit more slowly.
QRT	Shall I stop transmitting ?	Stop transmitting.
QRU	Have you anything for me ? ..	I have nothing for you.
QRV	Are you ready ?	I am ready. All is in order.
QRW	Are you busy ?	I am busy with another station (or with .... please do not interrupt).

QRX	Shall I wait ?	Wait. I will call you at .... o'clock (or when I want you).
QRY	What is my turn ?	Your turn is No. ....
QRZ	Are my signals weak ?	Your signals are weak.
QSA	Are my signals strong ?	Your signals are strong.
QSB	Is my tone bad ?	The tone is bad.
	Is my spark bad ?	The spark is bad.
QSC	Is the spacing bad ?	The spacing is bad.
QSD	Let us compare watches. My time is .... What is your time ?	The time is ....
QSF	Are the radiotelegrams to be transmitted alternately or in series ?	Transmission will be in alternate order.
QSG	—	Transmission will be in series of five radiotelegrams.
QSH	—	Transmission will be in series of ten radiotelegrams.
QSJ	What is the charge to collect for .... ?	The charge to collect is ....
QSK	Is the last radiotelegram cancelled ?	The last radiotelegram is cancelled.
QSL	Have you got the receipt ?	Please give a receipt.
QSM	What is your true course ?	My true course is .... degrees.
QSN	Are you communicating with land ?	I am not communicating with land.
QSO	Are you in communication with another station (or with ....) ?	I am in communication with .... (through the medium of ....).
QSP	Shall I signal to .... that you are calling him ?	Inform .... that I am calling him.
QSQ	Am I being called by .... ? ..	You are being called by ....
QSR	Will you dispatch the radiotelegram ?	I will forward the radiotelegram.
QST	Have you received a general call ? ..	General call to all stations.
QSU	Please call me when you have finished (or at .... o'clock)	I will call you when I have finished.
QSV	Is public correspondence engaged ?	Public correspondence is engaged. Please do not interrupt.
QSW	Must I increase the frequency of my spark ?	Increase the frequency of your spark.
QSY	Shall I transmit with a wave-length of .... metres ?	Let us transfer to the wave-length of .... metres.
QSX	Must I diminish the frequency of my spark ?	Diminish the frequency of your spark.

When an abbreviation is followed by a mark of interrogation it applies to the question indicated in respect of that abbreviation.

EXAMPLES.

Station.		
A	QRA ?	What is the name of your station ?
B	QRA Campania	This is the Campania.
A	QRG ?	To what company or line of navigation do you belong ?
B	QRG Cunard. QRZ	I belong to the Cunard Line. Your signals are weak.

Station A then increases the power of its transmitter and sends :

A	QRK ?	How are you receiving ?
B	QRK	I am receiving well.
	QRB 80	The distance between our stations is 80 nautical miles.
	QRC 62	My true bearings are 62 degrees, etc.

LAWS AND REGULATIONS

GREAT BRITAIN

FOLLOWING the termination of the meeting of the delegates at the International Conference in Berlin in 1903, the British Government drafted a Wireless Telegraphy Act to define the official position of the Postal and Telegraph Department in the United Kingdom in regard to the new development. The Act received Royal assent on August 15th, 1904, and the text is as follows :—

Wireless Telegraphy Act, 1904.

1.—(1) A person shall not establish any wireless telegraph station, or instal or work any apparatus for wireless telegraphy, in any place or on board any British ship except under and in accordance with a licence granted in that behalf by the Postmaster-General.

(2) Every such licence shall be in such form and for such period as the Postmaster-General may determine, and shall contain the terms, conditions, and restrictions on and subject to which the licence is granted, and any such licence may include two or more stations, places, or ships.

(3) If any person establishes a wireless telegraph station without a licence in that behalf, or instals or works any apparatus for wireless telegraphy without a licence in that behalf, he shall be guilty of a misdemeanour, and be liable, on conviction under the Summary Jurisdiction Acts, to a penalty not exceeding ten pounds, and on conviction on indictment to a fine not exceeding one hundred pounds, or to imprisonment, with or without hard labour, for a term not exceeding twelve months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this Act except by order of the Postmaster-General, the Admiralty, the Army Council, or the Board of Trade.

(4) If a justice of the peace is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship within his jurisdiction without a licence in that behalf, he may grant a search warrant to any police officer or any officer appointed in that behalf by the Postmaster-General, the Admiralty, the Army Council, or the Board of Trade, and named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station, place or ship, and to seize any apparatus which appears to him to be used, or intended to be used, for wireless telegraphy therein.

(5) Sections 684, 685, and 686 of the Merchant Shipping Act, 1894 (which relate to the jurisdiction of courts and justices), and section 693 of the same Act (which relates to distress for sums ordered to be paid by masters and owners of ships), shall apply to the jurisdiction of courts and justices in respect of ships, and to distress under this Act.

(6) The Postmaster-General may make regulations for prescribing the form and manner in which applications for licences under this Act are to be made, and, with the consent of the Treasury, the fees payable on the grant of any such licence.

(7) The expression "wireless telegraphy" means any system of communication by telegraph as defined in the Telegraph Acts, 1863 to 1904, without the aid of any wire connecting the points from and at which the messages or other communications are sent and received: Provided that nothing in this Act shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

2.—(1) Where the applicant for a licence proves to the satisfaction of the Postmaster-General that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions, and restrictions as the Postmaster-General may think proper, but shall not be subject to any rent or royalty.

(2) Where an applicant for a licence satisfies the Postmaster-General that a wireless telegraph station is to be used solely for the transmission of telegrams which are within the first or second exception from the exclusive privilege of transmitting telegrams conferred upon the Postmaster-General by the Telegraph Act, 1869, a licence for that purpose, if granted, shall not be subject to any rent or royalty.

(3) It shall be lawful for the Postmaster-General, due regard being had to the maintenance and exercise of effective control over wireless telegraphy, to grant special licences at reduced terms for the establishment and working of wireless telegraph stations to be used exclusively for the transmission within the United Kingdom of news to public registered newspapers. A schedule of all reduced rents or royalties imposed by any special licences shall be laid before both Houses of Parliament within fourteen days of the commencement of the session next succeeding the grant of any such licences.

3.—(1) This Act may be cited as the Wireless Telegraphy Act, 1904, and may be cited with the Telegraph Acts, 1863 to 1904.

(2) This Act shall extend to the whole of the British Islands and to all British ships in the territorial waters abutting on the coast of the British Islands, and the Royal Courts of the Channel Islands shall register this Act accordingly.

(3) His Majesty in Council may order that this Act shall, subject

to any conditions, exceptions, and qualifications contained in the order, apply during the continuance of the order to British ships whilst on the high seas.

(4) A person shall not work any apparatus for wireless telegraphy installed on a foreign ship whilst that ship is in territorial waters otherwise than in accordance with regulations made in that behalf by the Postmaster-General, and the Postmaster-General may, by any such regulations, impose penalties recoverable summarily for the breach of any such regulations not exceeding ten pounds for each offence, and may provide for the forfeiture on any such breach of any apparatus for wireless telegraphy installed or worked on such ship. Save as aforesaid, nothing in this Act shall apply to the working of apparatus for wireless telegraphy installed on any foreign ship.

4.—In the application of this Act to Scotland the expression " Misdemeanour " means crime and offence.

5.—In the application of this Act to the Channel Islands and the Isle of Man—

(1) The Lieutenant-Governor of the Island of Jersey or the Island of Guernsey, and the Governor, Lieutenant-Governor, or Deputy Governor of the Isle of Man, as the case may require, shall be substituted for the Board of Trade.

(2) Offences may be prosecuted, fines recovered, proceedings taken, and search warrants issued in such courts and in such manner as may for the time being be provided in the Channel Islands and the Isle of Man by law, or if no express provision is made then in and before the courts and in the manner in which the like offences, fines, proceedings, and warrants may be prosecuted, recovered, taken, or issued therein by law, or as near thereto as circumstances admit, and the bailiff or his lieutenant, or any Jurat of the Royal Court in the Island of Jersey or the Island of Guernsey, and the high bailiff or two justices of the peace in the Isle of Man, shall respectively be substituted for a justice of the peace.

6. This Act shall continue in force until the thirty-first day of July, nineteen hundred and six (*now the 31st day of December,* 1912), and no longer, unless Parliament otherwise determines. (It has now been extended indefinitely by the Expiring Laws Continuance Act.)

The following Order in Council is dated 29th February, 1908 :—

(1) The Wireless Telegraphy Act, 1904, shall apply to British ships whilst on the high seas, provided that a person on board a British ship which is registered in any British possession (other than the Channel Islands and the Isle of Man), or in any British Protectorate, shall not be deemed to commit an offence against the Wireless Telegraphy Act, 1904, by reason of the installation or working of wireless telegraphy on such ship if the authority in such Possession or Protectorate, having power by law so to do, shall have granted a licence

for the installation and working of apparatus for wireless telegraphy on that ship, and if such person is acting in accordance with the provisions of such licence.

(2) The Interpretation Act, 1889, shall apply for the purpose of the interpretation of this Order as it applies for the purpose of the interpretation of an Act of Parliament.

(3) This Order shall be published in the *London Gazette,* and shall come into operation immediately from and after the expiration of three months after this Order is so published.

(4) This Order may be cited as "The Wireless Telegraphy Order, 1908."

An Order was issued in 1908 (No. 496) containing regulations relating to foreign ships :—

1. In these Regulations unless the context otherwise requires—

"Wireless Telegraphy" has the same meaning as in the Wireless Telegraphy Act, 1904.

"Naval Signalling" means signalling by means of any system of wireless telegraphy between two or more ships of His Majesty's Navy, between ships of His Majesty's Navy and Naval Stations, or between a ship of His Majesty's Navy or a Naval Station and any other wireless telegraph station whether on shore or on any ship.

"Territorial Waters" means such part of the sea adjacent to the coast of the British Islands as is deemed by international law to be within the territorial sovereignty of His Majesty, and includes harbours.

"Harbour" includes harbours properly so called, whether natural or artificial estuaries, navigable rivers, piers, jetties, and other works in or at which ships can obtain shelter, or ship and unship goods or passengers.

2. When communications are made by means of wireless telegraphy between a foreign ship in territorial waters and a wireless telegraph station in the British Islands, the rules in force for the working of wireless telegraphy at that station shall be observed.

3. All apparatus for wireless telegraphy on board a foreign ship in territorial waters shall be worked in such a way as not to interrupt or interfere with—

(*a*) Naval Signalling, or

(*b*) the working of any wireless telegraph station lawfully established, installed, or worked in the British Islands or the territorial waters abutting on the coast of the British Islands, and in particular the said apparatus shall be so worked as not to interrupt or interfere with the transmission of any messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea.

4. (1) Except with the special permission in writing of the Postmaster-General no apparatus for wireless telegraphy on board a foreign ship (other than a ship of war) shall be worked or used whilst such ship is in any harbour in the British Islands.

(2) Without prejudice to the operation of the general provisions of these Regulations, the use of wireless telegraphy on board a foreign ship of war while in a harbour in the British Islands shall be subject to such rules (whether prohibitive or regulative) as may be made by the Admiralty from time to time.

5. (1) If at any time in the opinion of one of His Majesty's Principal Secretaries of State an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy, and notice to that effect is published by the Postmaster-General, after the publication of such notice and until further notice the use of wireless telegraphy on board foreign ships whilst in territorial waters shall be subject to such rules as may be made by the Admiralty from time to time, and such rules may prohibit or regulate such use in all cases or in such cases as may be deemed desirable.

(2) Such notice as aforesaid shall be published in the *London Gazette*, the *Edinburgh Gazette*, and the *Dublin Gazette*, and in such other manner, if any, as to the Postmaster-General may seem fit.

6. (1) Any person who shall offend against any provision of these Regulations or of any Rules made by the Admiralty thereunder shall be liable on conviction under the Summary Jurisdiction Acts for every such offence to a penalty not exceeding ten pounds, and upon such conviction the Court may order that any apparatus for wireless telegraphy installed or worked on board the ship on which the offence was committed shall be seized and forfeited.

(2) For the purposes of any proceedings under these Regulations the master or person being or appearing to be in command or charge of any Foreign ship shall be deemed to have authorised and to be responsible for the use or working of any apparatus on board such ship.

(3) Any summons or other document in any proceedings under these Regulations shall be deemed to have been duly served on the person to whom the same is addressed by being left on board the ship on which the offence is charged to have been committed with the person being or appearing to be in command or charge of the ship.

7. These Regulations shall not apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

8. These Regulations shall come into operation on the first day of July, 1908.

9. These Regulations may be cited as "The Wireless Telegraphy (Foreign Ships) Regulations, 1908."

The following is a copy of the form of Licence granted by the Postmaster-General to establish Wireless Telegraph Ship Stations :—

I the above-named —— —— His Majesty's Postmaster-General in exercise of all powers and authorities enabling me in this behalf do hereby grant to the Licensee during the term or period commencing on the day of the date hereof and terminating on the 31st day of December, 191 , licence and permission—

(i) To establish, instal, and work for the purposes hereinafter mentioned at the ship stations specified in the Schedule hereto and at such other ship stations as may be specified in any Supplemental Licence given from time to time under the hand of a Secretary to the Post Office apparatus for wireless telegraphy of the kind used in the system known as the —— —— system of wireless telegraphy (which apparatus is hereinafter referred to as " the licensed apparatus ").

Provided that—

(*a*) The apparatus installed at each ship station shall be of the character specified in the said schedule opposite to the name of such station or in any such Supplemental Licence as aforesaid;

(*b*) The apparatus used at all of the said ship stations shall be syntonised;

(*c*) The licensed apparatus shall be so constructed as to be capable of using wave-lengths of 300 metres in length as measured by the standard of measurement in use by the Post Office for the time being and such other wave-lengths not exceeding 600 metres in length as shall be authorised in writing from time to time by the Postmaster-General;

Provided that only wave-lengths of 300 metres shall be used by the Licensee during the period of any war in which the United Kingdom is engaged.

(*d*) The speed of transmission and reception of messages shall not in normal circumstances be less than 12 words a minute, five letters being counted as one word.

(ii) To transmit and receive messages by means of the licensed apparatus between the said ship stations and between the said ship stations and coast stations and other ship stations Provided that the transmission and receipt of messages from and at the said ship stations when in any harbour in the British Islands shall be subject to such conditions and restrictions as the Postmaster-General may prescribe from time to time; and

(iii) To receive money or other valuable consideration for or in respect of the use of the licensed apparatus or for or in respect of the transmission or receipt of messages by means of the said apparatus.

And I do hereby declare that the said licence and permission is granted on and subject to the following conditions and provisions:

1. In these presents (and in the Schedule hereto) the following words and expressions shall have the several meanings hereinafter assigned to them unless there be something either in the subject or context repugnant to such construction (that is to say):—

The expression "the Postmaster-General" means the Postmaster-General for the time being.

The expression "wireless telegraphy" has the same meaning as in the Wireless Telegraphy Act, 1904.

The term "telegraph" has the same meaning as in the Telegraph Act, 1969.

The expression "Naval signalling" means signalling by means of any system of wireless telegraphy between two or more ships of His Majesty's Navy between ships of His Majesty's Navy and Naval Stations or between a ship of His Majesty's Navy or a Naval Station and any other wireless telegraph station whether a coast station or a ship station.

The expression "the Admiralty" means the Commissioners for executing the office of Lord High Admiral of the United Kingdom of Great Britain and Ireland.

The expressions "the International Telegraph Convention" and "the International Telegraph Regulations" mean respectively the International Convention of St. Petersburg dated the 10th-22nd July, 1875, and the Service Regulations made thereunder and include respectively any modifications of the Convention or Regulations made from time to time.

The expression "the Radiotelegraphic Convention, 1906," means the Convention signed at Berlin on the 3rd day of November, 1906, and the Service Regulations made thereunder and includes any modification of the Convention or Regulations made from time to time.

The expression "coast station" means a wireless telegraph station which is established on land or on board a ship permanently moored, and which is open for the service of correspondence between the land and ships at sea.

The term "ship station" means a wireless telegraph station established on board a ship which is not permanently moored.

Apparatus shall be deemed to be "syntonised" when the transmitting apparatus is so adjusted as to communicate with a receiver which has a corresponding adjustment.

2. The licensed apparatus shall not be used by the Licensee or by any other person either on behalf or by permission of the Licensee for the transmission or receipt of messages except messages authorised by this Licence.

3. (1) The Licensee shall not by the transmission of any message by means of the licensed apparatus or otherwise by the use of the licensed apparatus interfere with Naval signalling.

(2) If the Admiralty are of opinion that the working of the licensed apparatus at any ship station specified in the Schedule hereto or in any such Supplemental Licence as aforesaid is inconsistent with the free use of Naval signalling the Licensee shall when required in writing by the Postmaster-General so to do close the said station.

(3) These provisions for the protection of naval signalling shall be construed to be without prejudice to the generality of any other provisions of this Licence.

4. For the purpose of this Licence the Licensee shall observe the International Telegraph Convention and the International Telegraph Regulations so far as the said Convention and Regulations are capable of being applied to wireless telegraphy in common with ordinary land and submarine telegraphy.

5. The Licensee shall observe the provisions of any Regulations from time to time under the provisions of the Telegraph Acts, 1863 to 1911, by the Postmaster-General with the consent of the Treasury in relation to the conduct of wireless telegraph business so far as the same are applicable to the Licensee.

6. The Licensee shall observe the provisions of the Radiotelegraphic Convention, 1906.

7. The Licensee shall comply with all such directions and observe all such rules as may be given or made by the Postmaster-General from time to time for the purpose of preventing interference with the working of any other wireless telegraph station and for enabling the messages exchanged by means of the licensed apparatus to be distinguished from those emanating from any other wireless telegraph station.

8. The licensed apparatus shall not without the consent of the Postmaster-General be altered or modified in respect of any of the particulars mentioned in the Schedule hereto or in any such Supplemental Licence as aforesaid.

9. The Licensee shall at all times indemnify the Postmaster-General against all actions claims and demands which may be brought or made by any corporation company or person in respect of any injury arising from any act licensed or permitted by these presents.

10. (1) Subject to the provisions of this Licence the Licensee shall transmit messages by means of the licensed apparatus on equal terms without favour or preference whether as regards rates of charge order of transmission or otherwise.

(2) In respect of messages transmitted on behalf of His Majesty's Government the Licensee shall charge rates not in excess of half of the rates charged to the ordinary public.

11. The Licensee shall so far as possible receive from ships and light stations all requests for assistance and all signals of distress and shall answer such requests and signals and re-transmit them with the least possible delay to the proper authorities by means of the licensed apparatus or any other means in the power of the Licensee.

12. The licensed apparatus at the said ship stations shall be worked only by a person or persons holding a certificate or certificates issued by the Postmaster-General. Certificates shall be granted to persons of such technical proficiency and shall be in such form and subject to such conditions as the Postmaster-General shall from time to time prescribe.

13. The Licensee shall not divulge to any person (other than properly authorised officials of His Majesty's Government or a competent legal tribunal) or make any use whatever of any message coming to the knowledge of the Licensee and transmitted by Naval signalling or by any system of wireless telegraphy provided or maintained by or for the purposes of the Postmaster-General or any Department of His Majesty's Government or by any Licensee of the Postmaster-General (other than the Licensee).

14. The Licensee shall keep full accounts records and registers of all messages transmitted by means of the licensed apparatus and in such registers each of such messages shall be accompanied by its identifying number and date and full particulars of its place of origin and of ultimate destination and such further particulars as the Postmaster-General shall from time to time reasonably require to be shown messages on His Majesty's service being in such registers distinguished from other messages. The Licensee shall preserve all used message forms written and printed and transcripts of messages and all other papers for such period as is from time to time prescribed by the Radiotelegraphic Convention, 1906, and in default of any provisions on the subject in the said Convention for such period as is from time to time prescribed by the International Telegraph Regulations and such registers and message papers shall be open to the inspection of the Postmaster-General or his officers thereto authorised at the —— —— —— Office of the Licensee in —— —— —— between the hours of 10 a.m. and 5 p.m. on every day except Sunday or a statute or general holiday.

15. The Postmaster-General and any agent authorised in that behalf in writing by him may at all reasonable times enter upon all or any of the ship stations hereby licensed for the purpose of inspecting and may inspect any apparatus fixed or being in such stations respectively for the purpose of sending and receiving messages by wireless telegraphy and all other telegraphic instruments and apparatus fixed or being in such

stations respectively and the working and user of such apparatus and telegraphic instruments respectively.

16. The Licensees shall carry on every ship on which a ship station is established under the Licence a print or copy of the Licence certified under the hand of an appropriate officer of the Postmaster-General to be a true copy and also such documents as may be prescribed by the Postmaster-General for the purpose of enabling the Licensee to communicate with coast stations in accordance with the Radiotelegraphic Convention, 1906.

17. The Licensee shall pay to the Postmaster-General for and in respect of the Licence hereby granted a royalty of five shillings per annum in respect of each ship station at which the licensed apparatus is installed.

18. (1) The Licensee shall on the 1st December next pay to the Postmaster-General for and in respect of the Licence hereby granted a royalty of five shillings per annum in respect of each ship station at which the licensed apparatus is installed.

(2) In the event of the renewal of this Licence the said royalty shall be payable on the same day in each succeeding year.

19. Except with the consent in writing of the Postmaster-General the Licensee shall not assign, underlet, or otherwise dispose of or admit any other person or body to participate in the benefit of the licences powers or authorities hereby granted or any of such licenses powers or authorities.

20. (1) If and whenever an emergency shall have arisen in which it is expedient for the public service that His Majesty's Government shall have control over the transmission of messages by the licensed apparatus it shall be lawful for any officer in command of any of His Majesty's ships of war to cause the licensed apparatus or any part thereof to be taken possession of in the name and on behalf of His Majesty and to be used for His Majesty's service and subject thereto for such ordinary services as to the said officer may seem fit and in that event any person authorised by the said officer may enter upon any ship on which any such apparatus is installed and take possession of the said apparatus and use the same as aforesaid.

(2) Any such officer may in such event as aforesaid instead of taking possession of the licensed apparatus as aforesaid direct and authorise such persons as he may think fit to assume the control of the transmission of messages by the licensed apparatus either wholly or partly and in such manner as he may direct and such persons may enter upon any ship on which any apparatus is installed accordingly or the said officer may direct the Licensee to submit to him or any person authorised by him all messages tendered for transmission or arriving by the licensed apparatus or any class or classes of such messages to stop or delay the transmission of any messages or deliver the same to him or

his agent and generally to obey all such directions with reference to the transmission of messages as the said officer may prescribe and the Licensee shall obey and conform to all such directions.

(3) The Licensee shall be entitled to reasonable compensation for any damage to the licensed apparatus arising in consequence of the exercise of the powers conferred by this Clause.

21. In any of the following cases (that is to say):—

(*a*) In case any sum of money which ought to be paid by the Licensee to the Postmaster-General under or by virtue of these presents shall be in arrear and unpaid for one calendar month after the time at which the same ought to be paid under or by virtue of the provisions herein contained or

(*b*) In case of any breach non-observance or non-performance by or on the part of the Licensee of any of the provisions (other than a provision for the payment of money) or conditions herein contained

then and in any such case the Postmaster-General may by notice in writing under his seal revoke and determine these presents and the licences powers and authorities hereinbefore granted and each and every of them as to all or any of the ship stations hereby licensed and thereupon these presents and the said licences powers and authorities and each and every of them shall absolutely cease determine and become void as to all or any of the said ship stations (as the case may be) but without prejudice to any right of action or remedy which shall have accrued or shall thereafter accrue to the Postmaster-General under any condition or provision herein contained.

22. Nothing in these presents contained shall prejudice or affect the right of the Postmaster-General from time to time to establish extend maintain and work any system or systems of telegraphic communication (whether of a like nature to that hereby licensed or otherwise) in such manner as he shall in his discretion think fit neither shall anything herein contained prejudice or affect the right of the Postmaster-General from time to time to enter into agreements for or to grant licences relative to the working and user of telegraphs (whether of a like nature to those hereby licensed or otherwise) or the transmission of messages in any part of the United Kingdom by means of wireless telegraphy or by any other means with or to any person or persons whomsoever upon such terms as he shall in his discretion think fit. And (save as in this Licence expressly provided) nothing herein contained shall be deemed to authorise the Licensee to exercise any of the powers or authorities conferred on or acquired by the Postmaster-General by or under the Telegraph Acts or any of them.

23. Any notice, request, or consent (whether expressed to be in writing or not) to be given by the Postmaster-General under these presents may be under the hand of any one of the secretaries or

assistant secretaries for the time being of the Post Office and may be served by sending the same in a registered letter addressed to the Licensee at the —— —— office for the time being of the Licensee or if such notice request or consent relates to any particular ship station by delivery to the master of the ship upon which such station is installed and any notice to be given by the Licensee under these presents may be served by sending the same in a registered letter addressed to the Secretary of the Post Office at the General Post Office, London.

The Schedule of Ship Stations before referred to.

1. Name of Ship on which Station established.	Normal Range of Sinalling in Nautical Miles. 2. By Night.	3. By Day.	Character of Apparatus. 4. Description of Receiving Apparatus	5. Wave-Lengths (in Metres).	6. Power. Source and Maximum Output.	Maximum to be taken by Transmitting Instruments.	7. If Alternator is used, Number of Cycles per Second.

COMMERCIAL COAST STATION LICENCE.

This is substantially the same as the Ship Station licence (pp. 83-9), except in the following details :—

The licence authorises the licensee—

(i.) To establish, instal and work for the purposes hereinafter mentioned at the coast stations specified in the Schedule hereto, apparatus for wireless telegraphy of the kind used in the system known as the system of wireless telegraphy (which apparatus is hereinafter referred to as " the licensed apparatus ") provided that (*a*) the apparatus installed at each station and the wave-lengths used thereat shall be of the character and length respectively specified in the said Schedule opposite to the name of such station; and (*b*) the Postmaster-General may for the purpose of facilitating communication by wireless telegraphy require the use at any of the said stations of wave-lengths other than and in addition to or in substitution for those specified as aforesaid in the said Schedule; (*c*) the apparatus used at all of the said stations shall be syntonised.

(ii.) To transmit and receive ship and coast messages by means of the licensed apparatus.

(iii.) To transmit and receive by means of the licensed apparatus between any one of the said stations and another messages incidental to the message hereinbefore authorised, but no other messages.

(iv.) To receive money or other valuable consideration for or in respect of the use of the licensed apparatus or for or in respect of the transmission or receipt of ship and coast messages by means of the said apparatus.

The licence is granted on and subject to the following conditions and provisions :—

1. In these presents the following words and expressions shall have their several meanings hereinafter assigned to them.

The expression "Coast Station" means a wireless telegraph station which is established on land or on board a ship permanently moored, and which is open for the service of correspondence between land and ships at sea.

The expression "ship and coast messages" means messages exchanged between ship and coast stations.

7. The licensee shall so work the licensed apparatus as not to interfere with the working of any wireless telegraph station established in the British Islands, or in territorial waters abutting on the coasts of the British Islands by or for the purposes of the Postmaster-General, or any other department of H.M. Government, or for commercial purposes, and, in particular, with the transmission or receipt of any ship and coast messages.

10. Subject to the provisions of this licence the licensee shall transmit messages by means of the licensed apparatus on equal terms without favour or preference, whether as regards rates of charge, order of transmission, or otherwise.

11.—(1) If and whenever any department of His Majesty's Government shall require the licensee, his servants or agents to transmit by means of the licensed apparatus any message on His Majesty's service (including messages to and from ships of His Majesty's Navy) such messages shall have priority over all other messages, and the licensee shall, as soon as reasonably mav be, transmit the same, and shall, until, and in so far as may be necessarv to effect such transmission, suspend the transmission of all other messages.

(2) The licensee shall not be entitled to claim any compensation in respect of the suspension of the transmission of messages as aforesaid.

(3) In respect of messages transmitted on behalf of His Majestv's Government, the licensee shall charge rates not in excess of half of the rates charged to the ordinary public.

14. The licensee shall employ British subjects only at the said coast stations.

17. The licensee shall render to the Postmaster-General such accounts as the Postmaster-General shall direct in respect of all charges due or payable under the Radiotelegraphic Convention, in respect of ship and coast messages, and shall pay to the Postmaster-General at such times and in such manner as the Postmaster-General shall direct, all sums which shall be due from the licensee under such accounts.

22. This is substantially the same as clause 20 of the ship station licence, but "one of His Majesty's principal Secretaries of State" has been substituted for "any officer in command of His Majesty's ships of war" in sub-sections (1) and (2).

23. The licence shall be determined—

(*a*) In case no station shall be established under these presents within from the date of these presents or having been established any station shall at any time cease to be duly maintained by the licensee for a period of continuously.

(*b*) In case any sum of money which ought to be paid by the licensee to the Postmaster-General, under or by virtue of these presents, shall be in arrear and unpaid for one calendar month after the time at which the same ought to be paid under or by virtue of the covenants herein contained, or

(*c*) In case of any breach, non-observance or non-performance by or on the part of the licensee of any of the provisions (other than a provision for the payment of money) or conditions herein contained.

25. All matters which in pursuance of the provisions herein contained are to be determined by arbitration shall be referred to arbitration in accordance with the provisions of the Arbitration Act, 1889, or any then subsisting statutory re-enactment or modification thereof.

The Schedule of Coast Stations before referred to.

1	Normal range of signalling.		Character of apparatus.		Power.		If alternator is used number of cycles per sec.
Name of coast station.	2 By night.	3 By day	4 Description of receiving apparatus.[1]	5 Wave-length (in metres).	6 Source and maximum output.	Maximum to be taken by transmitting instruments	

PRIVATE BUSINESS LICENCE.

This licence grants permission to establish, instal and work at the stations specified in the schedule thereto apparatus for wireless telegraphy, etc.; to transmit and receive messages on the private business of the licence.

2. (*a*) The licensed apparatus shall not be used by the licensee or by any person either on behalf or by permission of the licensee for any purpose except for the transmission and receipt of such messages as aforesaid between and at the stations specified in the schedule hereto.

(2) No money or other valuable consideration shall be received by the licensee or by any other person with the authority or by the permission of the licensee in respect of the transmission or receipt of any messages by means of the licensed apparatus or any part thereof.

3 (*b*) "Whenever the operators at any signal station of the licence perceive through the medium of the instruments used by them that naval signalling is proceeding they shall refrain from using the licensed apparatus until all indication that naval signalling shall have ceased."

4. The licensee shall observe the provisions of any regulations from time to time made under the provisions of the Telegraph Acts, 1863 to 1911, by the Postmaster-General with the consent of the Treasury in relation to the conduct of wireless telegraph business.

15. The Postmaster-General may at any time in his absolute discretion give notice in writing to determine these presents and the licence or permission hereby given at the end of one calendar month from the date of such notice and at the expiration of that period the licence or permission hereby granted shall cease and determine accordingly but without prejudice to any remedy of the Postmaster-General under any condition or provision herein contained.

Experimental Licence.

This licence provides that the licensed apparatus shall be worked and messages shall be transmitted and received solely for the purpose of conducting experiments in wireless telegraphy and for no other purpose whatever.

In October, 1912, the Board of Trade, at the request of the Lords Commissioners of the Admiralty, issued a notice directing the attention of Masters and Owners of British Merchant Vessels to the necessity for arranging for periodical practices in Wireless Telegraphy communications between H.M. Ships of War and Ships of the British Mercantile Marine for the purpose of ensuring efficient and reliable communication when required.

The co-operation is invited of all British ship-owners and masters whose ships are fitted with Wireless Telegraphy, in order to give effect to the following proposals.

(1) At 8.30 a.m. and 2.30 p.m. daily any single man of war (destroyers and small craft excluded) or one man of war in a fleet in company, detailed by the Senior Naval Officer present, will adjust her Wireless Telegraphy transmitting and receiving apparatus to the commercial 600 metre wave length and make the call "CCCC," followed by her own commercial call sign, indicating that she is prepared to carry out an exercise with any British merchant ship within range.

On a British merchant ship receiving this call she will answer and say whether or not she is prepared to proceed with the exercise. Should more than one merchant ship answer, the man of war will indicate which is to exercise and which is to wait.

The exercise will then proceed, but no messages are to be exchanged which are not authorised by the respective captains and masters of the ships practising. No message received during such exercises is to be forwarded beyond the ship actually receiving the message and no payment for any message can be made. The exercises are to be considered as strictly on Service and not for any commercial advantage.

(2) In all such exercises the man of war is to be considered the controlling ship.

(3) The exercises will cease at 9.15 a.m. and 3.15 p.m. respectively, or before, at the discretion of the captains concerned.

(4) These exercises are only to be carried out between vessels, neither of which are within 150 miles range of any commercial shore station using the 600 metre wave length, and are to cease at once should one of H.M. ships so direct.

THE UNITED STATES OF AMERICA

AN Act to amend an Act entitled " An Act to Require Apparatus and Operators for Radio Communication on certain Ocean Steamers," approved June 24th, 1910 :—

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled :—

1. That from and after 1st October, 1912, it shall be unlawful for any steamer of the United States or of any foreign country navigating the ocean or the Great Lakes and licensed to carry, or carrying, fifty or more persons, including passengers or crew or both, to leave or attempt to leave any port of the United States unless such steamer shall be equipped with an efficient apparatus for radio communication, in good working order, capable of transmitting and receiving messages over a distance of at least 100 miles, day or night. An auxiliary power supply, independent of the vessel's main electric power plant, must be provided which will enable the sending set for at least four hours to send messages over a distance of at least 100 miles, day or night, and efficient communication between the operator in the radio room and the bridge shall be maintained at all times.

The radio equipment must be in charge of two or more persons skilled in the use of such apparatus, one or the other of whom shall be on duty at all times while the vessel is being navigated. Such equipment, operators, the regulation of their watches, and the transmission and receipt of messages, except as may be regulated by law or international agreement, shall be under the control of the master, in the case of a vessel of the United States; and every wilful failure on the part of the master to enforce at sea the provisions of this paragraph

as to equipment, operators, and watches shall subject him to a penalty of $100.

That the provisions of this section shall not apply to steamers plying between ports, or places, less than 200 miles apart.

2. That this Act, so far as it relates to the Great Lakes, shall take effect on and after 1st April, 1913, and so far as it relates to ocean cargo steamers shall take effect on and after 1st July, 1913: Provided that on cargo steamers, in lieu of the second operator provided for in this Act, there may be substituted a member of the crew or other person who shall be duly certified and entered in the ship's log as competent to receive and understand distress calls or other usual calls indicating danger, and to aid in maintaining a constant wireless watch so far as required for the safety of life.

The remaining sections of the Act of June 24th, 1910, which are unchanged, read as follows :—

2. That for the purposes of this Act apparatus for radio communication shall not be deemed to be efficient unless the company installing it shall contract in writing to exchange, and shall, in fact, exchange, as far as may be physically practicable, to be determined by the master of the vessel, messages with shore or ship stations using other systems of radio communication.

Sec. 3. That the master or other person being in charge of any such vessel which leaves or attempts to leave any port of the United States in violation of any of the provisions of this Act shall, upon conviction, be fined in a sum not more than $5,000, and any such fine shall be a lien upon such vessel, and such vessel may be libelled therefor in any district court of the United States within the jurisdiction of which such vessel shall arrive or depart, and the leaving or attempting to leave each and every port of the United States shall constitute a separate offence.

Sec. 4. That the Secretary of Commerce and Labour shall make such regulations as may be necessary to secure the proper execution of this Act by collectors of customs and other officers of the Government.

Regulations

1. *Administration.*

1. The Department of Commerce and Labour has established the following districts for the purpose of enforcing the Acts relating to radio communication and the International Radiotelegraphic Convention, which will be in charge of radio inspectors stationed at ports named :—

(1) New England States (Boston, Mass.).

(2) New York and part of New Jersey (New York, N.Y.).

(3) Pennsylvania, part of New Jersey, Delaware, Maryland, Virginia (Baltimore, Md.).

(4) North and South Carolina, Georgia, Florida (Atlantic coast), Porto Rico (Savannah, Ga.).
(5) Gulf States and Florida (Gulf coast) (New Orleans, La.).
(6) California, Hawaii (San Francisco, Cal.).
(7) Oregon, Washington, Alaska (Seattle, Wash.).
(8) Great Lakes: New York, Pennsylvania, Ohio, Lower Michigan (Cleveland, Ohio).
(9) Great Lakes: Indiana, Illinois, Wisconsin, Minnesota, Upper Michigan (Chicago, Ill.).

Inspectors to do necessary work in the interior States will be detailed later.

2. Radio inspectors are authorised to communicate directly in their respective districts with collectors of customs, and to co-operate with them in the enforcement of the laws.

3. The radio inspectors and customs officers, as far as practicable, shall visit steamers subject to the Act, before they leave port, and ascertain if they are equipped with the apparatus in charge of the operators prescribed by the Act.

4. Where a steamer subject to the Act is without the apparatus and the operators prescribed, or either of them, and is about to attempt to leave port, the radio inspector or customs officer visiting the vessel shall—

(*a*) Notify the master of the fine to which he will be liable, and of the particulars in respect of which the law has not been complied with;
(*b*) notify at once the collector of customs, if necessary by telephone;
(*c*) prepare in writing a report of his action, stating particulars as in (*a*), to be transmitted to the collector of customs. The collector will transmit a copy to the United States Attorney for the district in which the port is situated.

5. The Act does not authorise the refusal of clearance in case of violation of its provisions, but specifically provides for the imposition of a fine in a sum not more than $5,000 upon conviction by the court. The collector of customs, accordingly, when advised that a steamer subject to the Act is attempting to leave port in violation of its requirements, shall at once notify the United States Attorney. Subsequently he shall report the case briefly to the Secretary of Commerce and Labour.

6. The Act does not apply to a vessel at the time of entering a port of the United States. Radio inspectors and customs officers may, however, accept as evidence of the efficiency of the apparatus and the skill of an operator messages shown to have been transmitted and received by him over a distance of at least 100 miles, by day, during the voyage to the United States.

7. In cases of violations of the Act the efficiency of the apparatus, and the skill of the operator will be determined by the court (see section 3 of the Act). Collectors of customs and radio inspectors, accordingly, are enjoined that the reports required by paragraphs 4 (*c*) of these regulations must be precise statements of the facts as the basis for proceedings by the United States Attorney.

8. Violations by the master of a vessel of the United States of the provisions of the second paragraph of section 1 will be reported to the collector of customs directly and the usual procedure in cases of navigation fines and penalties will be followed.

2. *Operators.*

1. Paragraphs 3 and 4 of Article VI. of the Service Regulations, annexed to the Berlin Radiotelegraphic Convention, which was ratified by the Senate of the United States on April 3, 1912, and is the law of the land, provides:

3. The service of the station on shipboard shall be carried on by a telegraph operator holding a certificate issued by the Government to which the vessel is subject. Such certificate shall attest the professional efficiency of the operator as regards—

(*a*) Adjustment of the apparatus;

(*b*) Transmission and acoustic reception at the rate of not less than 20 words a minute (Continental Morse);

(*c*) Knowledge of the regulations governing the exchange of wireless telegraph correspondence.

4. The certificate shall furthermore state that the Government has bound the operator to secrecy with regard to the correspondence.

The Berlin Convention has now been ratified by the principal maritime nations, dominions, and provinces. Radio operators holding valid certificates issued by foreign Governments (with exceptions named later) will be recognised by this Department as persons "skilled in the use of such apparatus" within the meaning of the Act unless in the case of a specific individual there may be special reason to doubt the operator's skill and reliability. Such certificates should be ready at hand for the inspection of radio or customs officers before the steamer departs from the United States.

The Berlin Convention has not been ratified by the following nations: China, Cuba, Dominican Republic, Haiti, Colombia, Ecuador, Peru, Panama, Venezuela, Costa Rica, Honduras, Nicaragua, and Salvador. In the case of a vessel under the flag of any of these nations, which is subject to the Act above, the radio operator, before the departure of the vessel from the United States, must furnish to the inspector evidence that he is "skilled in the use of the apparatus." This evidence shall consist of an examination on board by the radio inspector, if desired; or a certificate to be furnished on examination as certificates are furnished to operators on vessels of the United States.

2. (*a*) The Commissioner of Navigation will issue operators' certificates of skill (see Appendix A) in radio communication, and operators holding them will be recognised until December 13, 1912, as persons "skilled in the use of such apparatus" within the meaning of the Act, unless in the case of a specific individual there may be special reason to doubt the operator's skill and reliability. Such certificates should be ready at hand for the inspection of radio or customs officers before the ship departs from the United States.

(*b*) To secure a certificate an operator will pass an examination in the care and adjustment of apparatus, correction of faults, change from one wave length to another and care and use of storage battery or other auxiliary, transmission and sound reading at a speed of not less than fifteen words a minute American Morse, or twelve words Continental, as the operator may elect. Operators are advised to learn as soon as practicable the Continental system, which is required by the Berlin Convention, and after December 13, 1912, must be employed.

(*c*) The examinations will be held at the United States navy yards at Boston, Mass., Brooklyn, N.Y., Philadelphia, Pa., Washington, D.C., Norfolk, Va., Charleston, S.C., New Orleans, La., Mare Island (San Francisco), Cal., Puget Sound, Wash.; at the naval stations at Key West, Fla., San Juan, P.R., and Honolulu, Hawaii; at the Naval Academy, Annapolis, Md.; also at Fort Sam Houston, San Antonio, Tex., Fort Wood, New York Harbour, Fort Omaha, Nebr., Fort Leavenworth, Kans.; at the army stations at St. Michael, Alaska, and Fairbanks, Alaska; also at the Bureau of Standards, Washington, D.C.; and by the Department's radio inspectors at the custom-houses in their districts and elsewhere by arrangement with them. Applicants for certificates should communicate in writing with the commandants or commanding officers of the navy yards or army posts or naval or army stations named, or with the Director of the Bureau of Standards, or with the radio inspectors at the custom-houses, to ascertain the day and hour when they can be examined. Additional opportunities for examination can be ascertained by communicating with the Department's radio inspectors at the custom-houses or with the Commissioner of Navigation, Department of Commerce and Labour, Washington, D.C. The certificates will be delivered at the places of examination.

(*d*) After an applicant has secured a certificate he should go before a notary public to take the usual oath for the preservation of secrecy of messages received in the line of duty.

(*e*) These examinations for the present will be open to—

(1) Operators actually employed as such by a wireless or steamship company, including shore operators;

(2) Operators seeking employment as such by a wireless or steamship company, including shore operators;

(3) Applications for examination of operators of either class may be made by the wireless or steamship company in behalf of a number of operators by name;

(4) Applicants under 18 years of age must satisfy examining officers of their intention to secure employment as commercial operators, if passed.

(5) Women are eligible for examination under the conditions above.

3. Examinations under this Act are held for commercial operators. Examinations for amateurs under the Act to regulate radio communication will be provided for in a later circular.

4. Until December 13, 1912, when the act to regulate radio communication will take effect, a radio operator not possessing a certificate of skill as provided herein may present for the consideration of the radio inspector or visiting customs officer other competent evidence of skill, or the radio inspector may examine him, if practicable. If such examination be satisfactory, the radio inspector will issue a certificate.

5. *Note.*—The operator's certificate described in this circular is a voluntary arrangement for the convenience of commerce, and will not be accepted as the operator's licence required by the Act to regulate radio communication on and after December 13, 1912. Under that Act all operators will be required as a condition of employment to hold licences, based on the requirements of the Berlin Convention and the Act cited to carry it into effect. Operators on vessels of foreign countries which are parties to the Berlin Convention are required by the Convention to have licences. Copies of the Berlin Convention and of the Act cited may be obtained from the Commissioner of Navigation or the radio inspectors at the custom-houses named. Arrangements to carry out that Act and the Berlin Convention will be announced in a later circular.

3. *Apparatus.*

1. When the radio apparatus is certified as complying with the requirements of this Act by the competent authorities of a foreign Government, such certificate will be recognised by this Department, but the radio inspector or customs officer may, if he deem it necessary or desirable, satisfy himself that the apparatus is in good working order.

2. Whenever practicable, the radio inspector or customs officer shall satisfy himself on his visit before the departure of a steamer subject to the Act that the apparatus is efficient and in good working order within the meaning of the Act, and, if satisfied, he shall issue a certificate in the form in Appendix B. Duplicates of such certificates shall be retained in the files of the radio inspector or collector of customs.

3. When inspection of the apparatus by a radio inspector or customs officer is not practicable, the master of the steamer may

furnish to the visiting customs officer a certificate in the form of Appendix C. Such certificate shall be retained in the files of the collector of customs.

4. The current necessary to transmit and receive messages shall at all times while the steamer is under way be available for the radio operator's use.

5. On and after October 1, 1912, an auxiliary power supply, independent of the vessel's main electric power plant, must be provided which will enable messages to be sent for at least four hours over a distance of at least 100 miles, day or night. Adequate storage batteries best serve the purpose. Gasoline or kerosene auxiliary engines are not allowed under the steamboat inspection laws. The auxiliary power supply should be tested from time to time under service conditions and a record made by the operator.

6. On and after October 1, 1912, efficient communication between the radio room and the bridge must be maintained. A speaking tube or telephone will comply with this requirement.

7. One extra pair of head telephones, extra cords, and extra detectors should always be kept on hand. The absence of these and similar inexpensive emergency articles will be brought to the attention of the master and of the company installing the apparatus by the radio inspector in writing, and if after a reasonable interval they have not been supplied, the inspector will communicate the fact to the Commissioner of Navigation.

4. *Constant Watch.*

On vessels of the United States it is the statutory duty of the master to see that one operator is on duty at all times. The radio service of the ship is under the supreme authority of the master.

5. *Miscellaneous.*

1. The amended Act applies to vessels licensed to carry as well as those actually carrying 50 or more persons, etc.
2. Distances under the Act are to be computed in nautical miles.
3. Supplementary regulations for the Great Lakes will be issued before April 1, 1913.
4. Supplementary regulations for ocean cargo steamers will be issued before July 1, 1913.
5. Regulations under the Act to regulate radio communication and the licences required by that Act will be issued at an early date.

6. *Additions or Amendments.*

Additional or amendatory regulations will be issued from time to time as they may appear necessary.

BENJ. S. CABLE,
Acting Secretary.

APPENDIX A.—*Radio Service Form 751.*

Operator's Certificate of Skill in Radio Communication.

This is to certify that, under the provisions of the Act of June 24th, 1910, as amended by the Act of July 23, 1912, ——— ——— has been examined in radio communication and has passed in:

(*a*) The care and adjustment of apparatus, correction of faults, and change from one wave length to another, and care and use of storage battery or other auxiliary.

(*b*) Transmission and sound reading at a speed of not less than fifteen words a minute, American Morse, twelve words, Continental,* five letters counting as one word.

The candidate's practical knowledge of adjustment was tested on a ——— set of apparatus.† His knowledge of other systems and of international radio telegraphic regulations and American naval radio regulations is shown below: ——— ——— ———.

(Signature of examining officer) ——— ———.

Place ——— ———, Date ——— ———, 191—.

By direction of the Secretary of Commerce and Labour:

Commissioner of Navigation, Washington, D. C.

I, ——— ———, do solemnly swear that I will faithfully preserve the secrecy of all messages coming to my knowledge through my employment under this certificate; that this obligation is taken freely, without mental reservation or purpose of evasion; and that I will well and faithfully discharge the duties of the office: So help me God.

(Signature of holder) ——— ———.

Date of birth, ——— ———, ———. Place of birth, ——— ———.

Sworn to and subscribed before me this ——— day of ———, A.D. 191—.

[SEAL] ——— ———, *Notary Public.*

[On back of Form 751.]

SERVICE RECORD.

This is to certify that the holder of this certificate has served satisfactorily as radio operator under my command during the period named.

Name of Steamer.	Period.	Master.
....	From........., 19..., to........., 19...	....
....	From........., 19..., to ...., 19...	....

* "Passed 20 Continental" will be noted on the face of the certificates of applicants who have passed that test.

† It is not intended to limit the employment of the holder to a particular system, but merely to indicate the particular system in which he was tested for adjustment of apparatus.

The certificate is subject to suspension or revocation by the Secretary of Commerce and Labour for cause. It should be kept where it can be shown to radio or customs officers just before the ship leaves port.

APPENDIX *B.—Radio Service Form 752.*
Certificate of Radio Inspection.

PORT OF ——— ———,
——— ———, 191—.

This is to certify that I have to-day examined the apparatus for radio communication on the S.S. ———, of which ——— ——— is master, about to leave this port for ———, and I have found the same efficient and in good working order, as prescribed by the Act of June 24, 1910, as amended by the Act of July 23, 1912.

(Signed) ——— ———,
Radio Inspector.
(Or) ——— ———,
Customs Inspector.

APPENDIX C.—*Radio Service Form 753.*
Master's Certificate of Radio Apparatus.

The radio equipment must be in charge of two or more persons skilled in the use of such apparatus, one or the other of whom shall be on duty at all times while the vessel is being navigated. Such equipment, operators, the regulation of their watches, and the transmission and receipt of messages, except as may be regulated by law or international agreement, shall be under the control of the master, in the case of a vessel of the United States; and every wilful failure on the part of the master to enforce at sea the provisions of this paragraph as to equipment, operators, and watches shall subject him to a penalty of $100. (Act of July 23, 1912.)

PORT OF ——— ———,
——— ———, 191—.

This is to certify that I have to-day examined the apparatus for radio communication on the S.S. ———, of which I am master, about to leave this port for ———, and I have found the same efficient and in good working order, as prescribed by the Act of June 24, 1910, as amended by the Act of July 23, 1912.

(Signed) ——— ———, *Master.*

An Act to regulate radio-communication, approved August 13th, 1912:—

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a person, company, or corporation within the jurisdiction of the United States shall not use or operate any apparatus for radio communication as a means of commercial intercourse among the several States, or with foreign nations, or upon any vessel of the United States engaged in interstate or foreign commerce, or for the transmission of radiograms or signals the effect of which extends beyond the jurisdiction of the State or

Territory in which the same are made, or where interference would be caused thereby with the receipt of messages or signals from beyond the jurisdiction of the said State or Territory, except under and in accordance with a licence, revocable for cause, in that behalf granted by the Secretary of Commerce and Labour upon application therefor; but nothing in this Act shall be construed to apply to the transmission and exchange of radiograms or signals between points situated in the same State: *Provided,* That the effect thereof shall not extend beyond the jurisdiction of the said State or interfere with the reception of radiograms or signals from beyond said jurisdiction; and a licence shall not be required for the transmission or exchange of radiograms or signals by or on behalf of the Government of the United States, but every Government station on land or sea shall have special call letters designated and published in the list of radio stations of the United States by the Department of Commerce and Labour. Any person, company, or corporation that shall use or operate any apparatus for radio communication in violation of this section, or knowingly aid or abet another person, company, or corporation in so doing, shall be deemed guilty of a misdemeanour, and on conviction thereof shall be punished by a fine not exceeding $500, and the apparatus or device so unlawfully used and operated may be adjudged forfeited to the United States.

Sec. 2. That every such licence shall be in such form as the Secretary of Commerce and Labour shall determine, and shall contain the restrictions, pursuant to this Act, on and subject to which the licence is granted; that every such licence shall be issued only to citizens of the United States or Porto Rico or to a company incorporated under the laws of some State or Territory or of the United States or Porto Rico, and shall specify the ownership and location of the station in which said apparatus shall be used and other particulars for its identification and to enable its range to be estimated; shall state the purpose of the station, and, in case of a station in actual operation at the date of passage of this Act, shall contain the statement that satisfactory proof has been furnished that it was actually operating on the above-mentioned date; shall state the wave length or the wave lengths authorised for use by the station for the prevention of interference and the hours for which the station is licensed for work; and shall not be construed to authorise the use of any apparatus for radio communication in any other station that that specified. Every such licence shall be subject to the regulations contained herein, and such regulations as may be established from time to time by authority of this Act or subsequent Acts and treaties of the United States. Every such licence shall provide that the President of the United States in time of war or public peril or disaster may cause the closing of any station for radio communication and the removal therefrom of all

radio apparatus, or may authorise the use or control of any such station or apparatus, by any department of the Government, upon just compensation to the owners.

Sec. 3. That every such apparatus shall at all times, while in use and operation as aforesaid be in charge or under the supervision of a person or persons licensed for that purpose by the Secretary of Commerce and Labour. Every person so licensed who in the operation of any radio apparatus shall fail to observe and obey regulations contained in or made pursuant to this Act or subsequent Acts or treaties of the United States or any one of them, or who fail to enforce obedience thereto by an unlicensed person while serving under his supervision, in addition to the punishment and penalties herein prescribed, may suffer the suspension of the said licence for a period to be fixed by the Secretary of Commerce and Labour not exceeding one year. It shall be unlawful to employ any unlicensed person or for any unlicensed person to serve in charge or in supervision of the use and operation of such apparatus, and any person violating this provision shall be guilty of a misdemeanour, and on conviction thereof shall be punished by a fine of not more than $100 or imprisonment for not more than two months or both, in the discretion of the court, for each and every such offence: *Provided,* That in case of emergency the Secretary of Commerce and Labour may authorise a collector of customs to issue a temporary permit, in lieu of a licence, to the operator on a vessel subject to the radio ship Act of June 24, 1910.

Sec. 4. That for the purpose of preventing or minimising interference with communication between stations in which such apparatus is operated, to facilitate radio communication, and to further the prompt receipt of distress signals, said private and commercial stations shall be subject to the regulations of this section. These regulations shall be enforced by the Secretary of Commerce and Labour through the collectors of customs and other officers of the Government as other regulations herein provide for.

The Secretary of Commerce and Labour may, in his discretion, waive the provisions of any or all of these regulations when no interference of the character above mentioned can ensue.

The Secretary of Commerce and Labour may grant special temporary licences to stations actually engaged in conducting experiments for the development of the science of radio communication, or the apparatus pertaining thereto, to carry on special tests, using any amount of power or any wave lengths, at such hours and under such conditions as will ensure the least interference with the sending or receipt of commercial or Government radiograms, of distress signals and radiograms, or with the work of other stations.

In these regulations the naval and military stations shall be understood to be stations on land.

REGULATIONS.

1. *Normal Wave Length.*—Every station shall be required to designate a certain definite wave length as the normal sending and receiving wave length of the station. This wave length shall not exceed 600 metres or it shall exceed 1,600 metres. Every coastal station open to general public service shall at all times be ready to receive messages of such wave lengths as are required by the Berlin convention. Every ship station, except as hereinafter provided, and every coast station open to general public service shall be prepared to use two sending wave lengths, one of 300 metres and one of 600 metres, as required by the international convention in force: *Provided,* That the Secretary of Commerce and Labour may, in his discretion, change the limit of wave length reservation made by regulations 1 and 2 to accord with any international agreement to which the United States is a party.

2. *Other Wave Lengths.*—In addition to the normal sending wave length all stations, except as provided hereinafter in these regulations, may use other sending wave lengths: *Provided,* That they do not exceed 600 metres or that they do exceed 1,600 metres: *Provided further,* That the character of the waves emitted conforms to the requirements of regulations 3 and 4 following.

3. *Use of a "Pure Wave."*—At all stations if the sending apparatus, to be referred to hereinafter as the "transmitter," is of such a character that the energy is radiated in two or more wave lengths, more or less sharply defined, as indicated by a sensitive wave meter, the energy in no one of the lesser waves shall exceed 10 per cent. of that in the greatest.

4. *Use of a "Sharp Wave."*—At all stations the logarithmic decrement per complete oscillation in the wave trains emitted by the transmitter shall not exceed two-tenths, except when sending distress signals or signals and messages relating thereto.

5. *Use of "Standard Distress Wave."*—Every station on shipboard shall be prepared to send distress calls on the normal wave length designated by the international convention in force, except on vessels of small tonnage unable to have plants insuring that wave length.

6. *Signal of Distress.*—The distress call used shall be the international signal of distress:— . . . — — — . . .

7. *Use of Broad "Interfering Wave" for Distress Signals.*—When sending distress signals, the transmitter of a station on shipboard may be tuned in such a manner as to create a maximum of interference with a maximum of radiation.

8. *Distance Required for Distress Signals.*—Every station on shipboard, wherever practicable, shall be prepared to send distress signals of the character specified in regulations 5 and 6, with suffi-

cient power to enable them to be received by day over sea a distance of 100 nautical miles by a shipboard station equipped with apparatus for both sending and receiving equal in all essential particulars to that of the station first mentioned.

9. *"Right of Way" for Distress Signals.*—All stations are required to give absolute priority to signals and radiograms relating to ships in distress; to cease all sending on hearing a distress signal; and, except when engaged in answering or aiding the ship in distress, to refrain from sending until all signals and radiograms relating thereto are complete.

10. *Reduced Power for Ships near a Government Station.*—No station on shipboard, when within fifteen nautical miles of a naval or military station, shall use a transformer input exceeding one kilowatt, nor, when within five nautical miles of such a station, a transformer input exceeding one-half kilowatt, except for sending signals of distress, or signals or radiograms relating thereto.

11. *Intercommunication.*—Each shore station to general public service between the coast and vessels at sea shall be bound to exchange radiograms with any similar shore station and with any ship station without distinction of the radio systems adopted by such stations, respectively, and each station on shipboard shall be bound to exchange radiograms with any other station on shipboard without distinction of the radio systems adopted by each station, respectively.

It shall be the duty of each such shore station, during the hours it is in operation, to listen in at intervals of not less than fifteen minutes and for a period of not less than two minutes, with the receiver tuned to receive messages of 300 metre wave lengths.

12. *Division of Time.*—At important seaports and at all other places where naval or military and private or commercial shore stations operate in such close proximity that interference with the work of naval and military stations cannot be avoided by the enforcement of the regulations contained in the foregoing regulations concerning wave lengths and character of signals emitted, such private or commercial shore stations as do interfere with the reception of signals by the naval and military stations concerned shall not use their transmitters during the first fifteen minutes of each hour, local standard time. The Secretary of Commerce and Labour may, on the recommendation of the department concerned, designate the station or stations which may be required to observe this division of time.

13. *Government Stations to Observe Division of Time.*—The naval or military stations for which the above-mentioned division of time may be established shall transmit signals or radiograms only during the first fifteen minutes of each hour, local standard

time, except in case of signals or radiograms relating to vessels in distress, as hereinbefore provided.

14. *Use of Unnecessary Power.*—In all circumstances, except in case of signals or radiograms relating to vessels in distress, all stations shall use the minimum amount of energy necessary to carry out any communication desired.

15. *General Restrictions on Private Stations.*—No private or commercial station not engaged in the transaction of *bona fide* commercial business by radio communication or in experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wave length exceeding 200 metres, or a transformer input exceeding one kilowatt, except by special authority of the Secretary of Commerce and Labour contained in the licence of the station: *Provided,* That the owner or operator of a station of the character mentioned in this regulation shall not be liable for a violation of the requirements of the third or fourth regulations to the penalties of $100 or $25, respectively, provided in this section unless the person maintaining or operating such station shall have been notified in writing that the said transmitter had been found, upon tests conducted by the Government, to be so adjusted as to violate the said third and fourth regulations, and opportunity has been given to said owner or operator to adjust said transmitter in conformity with said regulations.

16. *Special Restrictions in the Vicinities of Government Stations.*—No station of the character mentioned in regulation 15 situated within five nautical miles of a naval or military station shall use a transmitting wave length exceeding 200 metres or a transformer input exceeding one-half kilowatt.

17. *Ship Stations to Communicate with Nearest Shore Stations.*—In general, the shipboard stations shall transmit their radiograms to the nearest shore station. A sender on board a vessel shall, however, have the right to designate the shore station through which he desires to have his radiograms transmitted. If this cannot be done, the wishes of the sender are to be complied with only if the transmission can be effected without interfering with the service of other stations.

18. *Limitations for Future Installations in Vicinities of Government Stations.*—No station on shore not in actual operation at the date of the passage of this Act shall be licensed for the transaction of commercial business by radio communication within fifteen nautical miles of the following naval or military stations—to wit: Arlington, Virginia, Key West, Florida, San Juan, Porto Rico, North Head and Tatoosh Island, Washington, San Diego, California; and those established or which may be established in

Alaska and in the Canal Zone; and the head of the department having control of such Government stations shall, so far as is consistent with the transaction of governmental business, arrange for the transmission and receipt of commercial radiograms under the provisions of the Berlin convention of 1906 and future international conventions or treaties to which the United States may be a party, at each of the stations above referred to and shall fix the rates therefor, subject to control of such rates by Congress. At such stations and wherever and whenever shore stations open for general public business between the coast and vessels at sea under the provisions of the Berlin convention of 1906 and future international conventions and treaties to which the United States may be a party shall not be so established as to ensure a constant service day and night without interruption, and in all localities wherever and whenever such service shall not be maintained by a commercial shore station within 100 nautical miles of a naval radio station, the Secretary of the Navy shall, so far as is consistent with the transaction of Government business, open naval radio stations to the general public business described above, and shall fix rates for such service, subject to control of such rates by Congress. The receipts for such radiograms shall be covered into the Treasury as miscellaneous receipts.

19. *Secrecy of Messages.*—No person or persons engaged in or having knowledge of the operation of any station or stations shall divulge or publish the contents of any messages transmitted or received by such station, except to the person or persons to whom the same may be directed, or their authorised agent, or to another station employed to forward such message to its destination, unless legally required so to do by the court of competent jurisdiction or other competent authority. Any person guilty of divulging or publishing any message, except as herein provided, shall, on conviction thereof, be punishable by a fine of not more than $250 or imprisonment for a period of not exceeding three months, or both fine and imprisonment, in the discretion of the court.

20. *Penalties.*—For violation of any of these regulations, subject to which a licence under sections 1 and 2 of this Act may be issued, the owner of the apparatus shall be liable to a penalty of $100, which may be reduced or remitted by the Secretary of Commerce and Labour, and for repeated violations of any such regulations the licence may be revoked.

For violation of any of these regulations, except as provided in regulation 19, subject to which a licence under section 3 of this Act may be issued, the operator shall be subject to a penalty of $25, which may be reduced or remitted by the Secretary of Com-

merce and Labour, and for repeated violations of any such regulations the licence shall be suspended or revoked.

Sec. 5. That every licence granted under the provisions of this Act for the operation or use of apparatus for radio communication shall prescribe that the operator thereof shall not wilfully or maliciously interfere with any other radio communication. Such interference shall be deemed a misdemeanour, and upon conviction thereof the owner or operator, or both, shall be punishable by a fine of not to exceed $500 or imprisonment for not to exceed one year, or both.

Sec. 6. That the expression "radio communication" as used in this Act means any system of electrical communication by telegraphy or telephony without the aid of any wire connecting the points from and at which the radiograms, signals, or other communications are sent or received.

Sec. 7. That a person, company, or corporation within the jurisdiction of the United States shall not knowingly utter or transmit, or cause to be uttered or transmitted, any false or fraudulent distress signal or call or false or fraudulent signal, call, or other radiogram of any kind. The penalty for so uttering or transmitting a false or fraudulent distress signal or call shall be a fine of not more than $2,500 or imprisonment for not more than five years, or both, in the discretion of the court, for each and every such offence, and the penalty for so uttering or transmitting, or causing to be uttered or transmitted, any other false or fraudulent signal, call, or other radiogram shall be a fine of not more than $1,000 or imprisonment for not more than two years, or both, in the discretion of the court, for each and every such offence.

Sec. 8. That a person, company, or corporation shall not use or operate any apparatus for radio communication on a foreign ship in territorial waters of the United States otherwise than in accordance with the provisions of sections 4 and 7 of this Act and so much of section 5 as imposes a penalty for interference. Save as aforesaid, nothing in this Act shall apply to apparatus for radio communication on any foreign ship.

Sec. 9. That the trial of any offence under this Act shall be in the district in which it is committed, or if the offence is committed upon the high seas or out of the jurisdiction of any particular State or district, the trial shall be in the district where the offender may be found or into which he shall be first brought.

Sec. 10. That this Act shall not apply to the Philippine Islands.

Sec. 11. That this Act shall take effect and be in force on and after four months from its passage.

Amateur Stations

Under the new Act governing amateur stations it is forbidden for a private person, unless he has a licence, to use transmitting

apparatus powerful enough to send signals across the boundaries of the State in which he dwells, or with sufficient energy to be detected by a sensitive receiving set just beyond the State boundaries, or powerful enough to interfere with the reception by others of the signals beyond the State boundaries. The licensed amateur may so transmit messages, but he must not, without special licence, use a wave-length of more than 200 metres, or a power input to his transmitting apparatus of more than 1 kw. If he is within more than five nautical miles of a military or naval station, his wave-length must not be more than 200 metres, nor his power input more than ½ kw. The penalty for operating a station without a licence after December 13th, 1912, is a fine of not more than $500 and the forfeiture of the apparatus.

Messages may be received from any direction, and on any wave-length, without licence, provided the station is not equipped for sending. If the station is equipped for sending as well as receiving, then the owner must possess both a station licence and an operator's licence, and he is forbidden to permit an unlicensed person to use his sending apparatus except under direct supervision. The penalty for failure to observe the latter provision is a fine of not more than $100, or imprisonment for not more than two months, or both, as provided in Section III. of the Act. For repeated violations of the law the licence is liable to forfeiture.

The sending wave must be sharply tuned, and the fourth regulation requires that "at all stations the logarithmic decrement per complete oscillation in the wave-trains emitted by the transmitter shall not exceed two-tenths, except when sending distress signals or signals and messages relating thereto." This provision sounds rather mysterious, and is not a little formidable, but it is simply a statement of the damping permitted in the wave-trains sent out by the aerial. Amateurs will not often find it possible to plot an actual curve of the current in the aerial, as the only method of determining the value of the logarithmic decrement is by means of a decremeter or some similar instrument, which is sometimes beyond the power of their purpose. The limit to the damping is specified in order to provide a wave that may be tuned without much trouble, as it is well known that a wave in which the damping is slight may be sharply tuned and easily tuned out, while a highly damped wave may be heard all along the tuning aerial, and is nearly as loud at one point as at another. If the transmitter is so adjusted that the wave radiated by the aerial

does not conform to this regulation an opportunity will be given the owner to readjust it so as to avoid violating the law, which would mulct him in penalties of $100.

Absolute right-of-way must be given to distress signals and to messages relating thereto, and the owner of a private station must stop sending if told by a Government or commercial station operator that he is interfering with reception of distress signals or messages relating thereto. The penalty for failure to observe this regulation is a fine of $100, and for repeated offences the forfeiture of his licence in addition. In no case, except in the case of signals relating to vessels in distress, may the private owner use more power than is necessary to carry his messages to the station with which he is communicating or wishes to communicate. He must not divulge the contents of any message he receives or intercepts except to the person for whom such message is intended, or to another station which is to forward the message to its destination, unless required to do so in a court of law. The penalty in this case is a fine of not more than $250, or imprisonment for three months, or both. The effect of this prohibition should be to prevent an amateur from keeping for the inspection of his friends or visitors copies of interesting private messages he may receive or intercept.

Wilful interference is one of the principal causes that made Government regulation of wireless communications necessary, and it is interesting to note that the penalty for wilful interference is particularly severe. The owner, or operator, or both, may be subject to a fine up to $500, or imprisonment for one year, or both, for interference with Government or commercial messages, and in all probability the licence would be forfeited for interfering with the work of other amateurs. Severe punishment will be meted out to the person who transmits, or permits anyone else to transmit, while using his sending apparatus, any false or fraudulent distress signals or calls, or any other false or fraudulent signal, call, or message of any kind. The penalty for sending out a false distress signal or call is a fine of not more than $2,500, or imprisonment for not more than five years, or both, for each and every such offence. And the penalty for sending out, or permitting to be sent out, any false or fraudulent signal, call, or message, is a fine of not more than $1,000, or imprisonment for not more than two years, or both, for each and every offence.

The amateur must have a station licence if his station is

equipped for sending, and he must also have a licence at least equal to that of a first-grade operator. He may receive messages without either licences if his station is equipped with receiving apparatus only, but he should obtain an operator's licence if he is capable, because an unlicensed person may not operate a sending apparatus in any station except as an apprentice actually serving under a licensed operator for the purpose of learning the art.

The United States Court, at Norfolk (Virginia), decided recently that vessels entering American ports for bunker coal only are not subject to the provisions of the U.S. Wireless Telegraph Act, making it compulsory for certain classes of vessels to carry wireless telegraph outfits.

CANADA

Part IV.

Wireless Telegraphy in the Dominion has been regulated by Part IV. of the Telegraphs Act, of which the following is an extract:—

In this part of the Act " Minister " means the Minister of Marine and Fisheries. The chief clauses are as follows:—

40. No person shall establish any wireless telegraph station, or instal or work any apparatus for wireless telegraphy, in any place or on board any ship registered in Canada except under and in accordance with a licence granted in that behalf by the Minister with the consent of the Governor-in-Council.

41. (1) Every such licence shall be in such form and for such period as the Minister determines, and shall contain the terms, conditions and restrictions on and subject to which the licence is granted.

(2) Any such licence may include two or more stations, places or ships.

42. Where the applicant for a licence proves to the satisfaction of the Minister that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions and restrictions as the Minister thinks proper.

43. The Minister may make regulations for prescribing the form and manner in which applications for licences under this part are to be made, and, with the consent of the Governor-in-Council, may prescribe the fees payable on the grant of any such licence.

44. (1) If a Justice of the Peace is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without licence in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship within his jurisdiction without a licence in that behalf, he may grant a search warrant to any police officer or any officer appointed in that behalf by the Minister and named in the warrant.

(2) A warrant so granted shall authorise the officer named therein to enter and inspect the station, place or ship, and to seize any apparatus which appears to him to be used or intended to be used for wireless telegraphy therein.

45. No proceedings shall be taken against any person under this part, except by order of the Minister.

46. Every one who establishes a wireless telegraph station, or instals or works any apparatus for wireless telegraphy, without a licence in that behalf, shall be guilty of an offence punishable on summary conviction or on indictment and be liable, on summary conviction, to a penalty not exceeding $50, and on conviction or indictment to a fine not exceeding $500 or to imprisonment for a term not exceeding twelve months, and in either case shall be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence.

Revised legislation is now under consideration of the Canadian Parliament, and the following are the chief provisions of the Bill before the House at the time of writing :—

From and after the first day of July, 1913, no steamer, whether registered in Canada or not, carrying fifty or more persons, including passengers and crew, shall leave or attempt to leave any Canadian port unless such steamer is equipped with an efficient radio telegraph apparatus in good working order, capable of transmitting and receiving messages over a distance of at least 100 miles by night and by day, and in charge of a person fully qualified to take charge of and operate such apparatus.

The owner, master, or other person in charge of any steamer which leaves or attempts to leave any Canadian port contrary to the provisions of this section shall, on summary conviction, be liable to a fine not exceeding $1,000 and costs, and such fine and costs shall constitute a lien upon such steamer.

This section shall not apply to steamers plying between ports not more than 200 miles apart.

All persons operating land or telegraph stations shall transmit

all messages to and from ship, *via* coast stations, under rules made by Board of Railway Commissioners.

6. (1) Operators to be British subjects, and take declaration of secrecy.

(2) Penalty for divulging information, $100 and imprisonment not exceeding six months.

7. Sending false messages or obstructing communication, penalty $500 and costs and six months' imprisonment.

8. Powers to Justice of Peace to grant warrant to search for apparatus established without licence.

9. (1) Everyone who instals or works apparatus contrary to Act, liable, on summary conviction, to penalty of $50, and on conviction on indictment $500 and imprisonment not exceeding twelve months and forfeiture of apparatus.

(2) No proceedings to be taken against any person except by order of the Minister.

10. (1) Fees to be paid for licences and for examination for certificate.

(2) Governors' power re international conventions.

11. (1) Minister may make regulations:—

(*a*) As to form of application for licences;

(*b*) classifying stations, etc.;

(*c*) defining licences;

(*d*) conditions and restrictions re licences;

(*e*) different classes of certificate;

(*f*) examinations for certificates;

(*g*) number of operators, watches, etc.;

(*h*) inspection;

(*i*) operation of apparatus on British or foreign ships on Canadian waters, same as (*d*) *48*, in Bill 116;

(*j*) stations to transmit messages to each other, same as (*a*) and (*b*) *48* in Bill 116;

(*k*) for carrying out the Act.

(2) Penalty for violation of any of the above regulations, $50.

12. Regulations to be published and laid before Parliament.

13. (1) Power of Government to take possession of stations, etc.

(2) Recompensation for above.

Regulations to Govern the Operation of Amateur Stations.

1. The wave length is not to exceed 50 metres (this means the aerial must not exceed 30 ft. in length; there will be no limit to the number of wires which may be used in parallel in the same).

2. The power absorbed by the primary of the transformer or induction coil is not to exceed $\frac{1}{2}$ k.w.

3. The aerial must be connected to the transmitting apparatus

only when messages are being transmitted or when measurements are being taken. At all other times, such as when the spark is being tested or sending is being practised, the aerial must be disconnected from the transmitter.

4. A distinctive call signal is to be allotted to each station, all such calls being commenced with the letter "X"—*e.g.*, XAA, XAB.

5. The station must take every precaution to prevent interference with other stations.

6. The station, when working, must listen for the signal "STP," which will indicate that an experimental station is interfering with commercial business.

7. The latter signal will only be made use of by certain authorised Government stations, and will not be used unless absolutely necessary. The signal "STP" will be preceded by the signal allotted to the experimental station whenever possible, and will be followed by the signal of the controlling station. On receipt of the above signal the experimental station will cease to operate until the controlling station gives the signal "Cancel STP."

Regulations to Govern the Operation of Experimental Wireless Stations.

1. The station is to be worked only by operators holding a Canadian Government "Operator's certificate," unless a wave length below 100 metres is used; the wave length will be specified in the licence.

2. A distinctive call signal will be allotted to each station, commencing with the letter "X"—*e.g.*, XAA, XAB.

3. The wave lengths reserved for naval signalling (600 to 1,600 metres) are to be strictly avoided.

4. The station, as far as possible, is to be operated in accordance with the Regulations of the International Radiotelegraphic Convention.

5. The station must take every precaution to prevent interference with other stations, including the avoidance in working of wave lengths which are being used between other stations, and must, before commencing to transmit a message, be sure that no commercial stations are working.

6. The station, when working, must listen for the signal "STP," which will indicate that an experimental station is interfering with commercial business.

7. The latter signal will only be made use of by certain authorised Government stations, and will not be used unless absolutely necessary. The signal "STP" will be preceded by the signal allotted to the experimental station, and will be followed by the signal of the controlling station. On receipt of the above signal the experimental

station will cease to operate until the controlling station gives the signal "Cancel STP."

8. The aerial must be connected to the transmitting apparatus only when messages are being transmitted or when measurements are being taken. At all other times, such as when the spark is being tested or sending is being practised, the aerial must be disconnected from the transmitter.

9. The power used must not exceed ½ k.w.

10. The transmitting apparatus must be of the coupling type, and must comply with the following conditions :—

(*a*) Whatever may be the wave length for which the station is licensed, if

w1 the longer wave length emitted
w2 the shorter wave length emitted,
then 200 (w1—w2) should be less

$w_1—w_2$

than 10.

(*b*) If one or more spark gaps are used in the transmitting aerial, then the sum of such spark gaps shall not exceed 1 mm.

11. The station must be connected with the local telephone exchange, so that instant communication can be established with the local Government station.

NEWFOUNDLAND

WIRELESS telegraphy in Newfoundland is governed by the Post and Telegraph Acts, 1891 to 1906. The 1906 Act reads as follows :—

1.—(1) A person shall not establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy, in any place in this Colony, or on board any ship registered in this Colony, except under and in accordance with a licence granted in that behalf by the Postmaster-General, with the consent of the Governor in Council.

(2) Every such licence shall be in such form and for such period as the Postmaster-General may determine, and shall contain the terms, conditions, and restrictions on and subject to which the licence is granted, and any such licence may include two or more stations, places or ships.

(3) If any person establishes a wireless telegraph station without a licence in that behalf, or instals or works any apparatus for wireless telegraphy without a licence in that behalf, he shall be guilty of a misdemeanour, and be liable on conviction in a summary manner before a Stipendiary Magistrate to a penalty not exceeding fifty dollars, and on conviction on indictment to a fine not exceeding five hundred dollars, or to imprisonment, with or without hard labour, for a term not exceed-

ing twelve months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this Act except by order of the Postmaster-General.

(4) If a Stipendiary Magistrate is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship as aforesaid without a licence in that behalf, he may grant a search warrant to any police officer or any officer appointed in that behalf by the Postmaster-General, and named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station, place or ship, and to seize any apparatus which appears to him to be used, or intended to be used, for wireless telegraphy therein.

(5) When a fine under this Act is imposed by a Court, Judge or Magistrate, and the master or owner of any ship is ordered to pay the same and the same is not paid at the time and in the manner prescribed, the Court, Judge, or Magistrate making the order may, in addition to any other powers they may have for the purpose of compelling payment, direct the amount remaining unpaid to be levied by distress and sale of the ship, her tackle, furniture and apparel.

(6) The Postmaster-General may make regulations for prescribing the form and manner in which applications for licences under this Act are to be made, and with the consent of the Governor in Council, the fees payable on the grant of any such licence.

(7) The expression "wireless telegraphy" means any system of communication by telegraph as defined in "The Post and Telegraph Acts, 1891 to 1904," without the aid of any wire connecting the points from and at which the messages or other communications are sent and received.

2. This Act shall be read with and form part of "The Post and Telegraph Acts, 1891 to 1904," and the said Acts and this Act may be cited as "The Post and Telegraph Acts, 1891 to 1906."

The Act of 1905, Cap. VII., refers to taxes upon business transacted by telegraph and telephone companies within and in transit through the Colony. Clause 2, Section 2, reads as follows:—

> A sum equal to one per cent. in manner hereinafter provided of the total amount received by or due to the company in respect of all telegraphic messages passing over the land lines of the company or transmitted or received by any wireless method of telegraphy to or from any place within this Colony from or to any other place within this Colony during a period of twelve calendar months ending on the first day of May of each year: Provided that this

sub-section shall not apply to messages which originate or are delivered in any place outside the Colony.

The first of such payments shall be made on the 30th day of June, 1906, in respect of the period of twelve months ending on the preceding first day of May.

Section 4 of the same Clause (2) reads as follows:—

A sum of four thousand dollars ($4,000) in respect of every wireless telegraph station or other means of communication by wireless methods of telegraphy between this Colony and any place, ship or vessel outside this Colony, for the time being belonging to or worked by or on behalf of the company which now is or hereafter shall be established in this Colony.

The first of such payments shall be made on the 30th day of June, 1906: Provided that if the Governor in Council is satisfied that any such wireless telegraph station or other such means of communication is established for the purpose only of reporting passing ships or vessels, he may dispense the payment of such last-named sum and discharge the company from liabilitv therefor in respect of such station or means of communication.

Clause 1 (1) of the Act of June 15th, 1905, Cap. XXI., reads:—

Whenever in the opinion of the Governor an emergency shall have arisen in which it is expedient for the public service that the Government of the Colony shall have control over the transmission of messages over any telegraph line, telephone line, or by any other form of telegraphy, it shall be lawful for the Governor in Council at any time to assume and for any length of time retain possession of any telegraph line, telephone, or any form of telegraphy in this Colony, and of all things necessary for the efficient working thereof, and may for the same time require the exclusive service of the operators and other persons employed in working such telegraph line, telephone, or any form of telegraphy; and the company or other proprietor of such telegraph line, telephone, or any form of telegraphy, shall give up possession thereof, and the operators and other persons so employed shall, during the time of such possession, diligently and faithfully obey such orders and transmit and receive such despatches as they are required to receive and transmit by any officer duly authorised by the Governor in Council, and every company or other proprietor, operator or person violating any of the provisions of this section shall incur a penalty not exceeding one hundred dollars ($100) for every refusal or neglect to comply with the requirements thereof, such penalty to be recovered by action in the name of the Minister of Finance and Customs, in a summary manner before a Stipendiary Magistrate or Justice of the Peace.

In 1906 an agreement was made under which the Marconi Wireless Telegraph Company of Canada undertook to operate

all the Labrador stations during the fishing season of each year, the Newfoundland Government to pay the company an annual royalty, and the revenue accruing from this traffic to go to the latter, who further agreed to forward all traffic over the Newfoundland Government Postal Telegraph System.

The success of this arrangement prompted the Government to propose an extension of the system on the Labrador by two or more stations—the Marconi Company to erect and operate these stations on the terms provided in the agreement. In the summer of 1910 stations were accordingly erected by the Marconi Company at Cape Harrison and Mokkovik. In 1911 it was agreed to establish a station between Indian Harbour and Cape Harrison to complete the chain on the Labrador.

After further negotiations, an important agreement was executed in December, 1912, which covers the following points: The old agreement terminating in 1916 is extended for a further period of ten years, terminating in 1926; all other undertakings entered into in the earlier agreement will be continued until 1926; the Marconi Company to erect and operate a station at Fogo, on the East Coast of Newfoundland—this station to be the property of the Marconi Company, and to be exempt from the Government tax of $4,000 during the term of the agreement.

AUSTRALIA

THE Postmaster-General's Department controls commercial wireless telegraphy in the Commonwealth. The first Act was passed in 1905, and is as follows:—

No. 8 OF 1905.

1. *Short Title.*—This Act may be cited as the Wireless Telegraphy Act, 1905.

2. *Interpretation.*—In this Act—

"Australia" includes the territorial waters of the Commonwealth and any territory of the Commonwealth;

"Wireless Telegraphy" includes all systems of transmitting and receiving telegraphic messages by means of electricity without a continuous metallic connection between the transmitter and the receiver.

3. *Exemption of Ships of War.*—This Act shall not apply to ships belonging to the King's Navy.

4. *Exclusive Privileges of Postmaster-General.*—The Postmaster-

General shall have the exclusive privilege of establishing, erecting, maintaining, and using stations and appliances for the purpose of—

(*a*) transmitting messages by wireless telegraphy within Australia, and receiving messages so transmitted, and

(*b*) transmitting messages by wireless telegraphy from Australia to any place or ship outside Australia, and

(*c*) receiving in Australia messages transmitted by wireless telegraphy from any place or ship outside Australia.

5. *Licences.*—Licences to establish, erect, maintain, or use stations and appliances for the purpose of transmitting or receiving messages by means of wireless telegraphy may be granted by the Postmaster-General for such terms and on such conditions and on payment of such fees as are prescribed.

6. *Penalty for Breach of Act.*—(1) Except as authorised by or under this Act, no person shall—

(*a*) establish, erect, maintain, or use any station or appliance for the purpose of transmitting or receiving messages by means of wireless telegraphy; or

(*b*) transmit or receive messages by wireless telegraphy.

Penalty: Five hundred pounds, or imprisonment with or without hard labour for a term not exceeding Five years.

Ships Fitted with Apparatus for Wireless Telegraphy.—(2) Subsection (1) of this section shall not, except as prescribed, extend to appliances maintained on any ship, arriving from any place beyond Australia, for the purpose of enabling messages to be transmitted from or received on that ship by means of wireless telegraphy, but all such appliances shall, while the ship is within Australia—

(*a*) be subject to the control of the Postmaster-General; and

(*b*) only be used by his authority or as authorised by the regulations.

Penalty: Five hundred pounds.

7. *Forfeiture of Appliances Unlawfully Erected.*—All appliances erected, maintained, or used in contravention of this Act or the regulations, for the purpose of transmitting or receiving messages by means of wireless telegraphy, shall be forfeited to the King for the use of the Commonwealth.

8. *Search Warrants for Appliances Unlawfully Erected.*—(1) If a justice of the peace is satisfied by information on oath that there is reasonable ground for supposing that any appliance is established, erected, maintained, or used in contravention of this Act or the regulations, for the purpose of transmitting or receiving messages by means of wireless telegraphy, he may grant a search warrant to any person.

(2) A search warrant under this section shall authorise the person to whom it is addressed to break and enter any place or ship, where the appliance is or is supposed to be, either by day or by night, and to seize

all appliances which appear to him to be used or intended to be used for transmitting or receiving messages by means of wireless telegraphy.

9. *Proceedings in Respect of Offences.*—(1) Proceedings for any offence against this Act may be instituted in any Court of Summary Jurisdiction, and any person proceeded against under this section may be dealt with summarily or may be committed for trial.

(2) The Court in dealing summarily with any accused person under this section may, if he is found guilty of any offence against this Act, punish him by imprisonment with or without hard labour for any period not exceeding six months, or by a penalty not exceeding Fifty pounds.

10. *Regulations.*—The Governor-General may make regulations, not inconsistent with this Act, prescribing all matters which by this Act are required or permitted to be prescribed or which are necessary or convenient to be prescribed for carrying out or giving effect to this Act.

Statutory Rules.

No. 216, 1911.

In 1911, the Governor-General, acting with the advice of the Federal Executive Council, issued regulations under the Act of 1905, and these came into force on January 13th, 1912.

In these regulations, "Australian ship" means a ship registered in Australia; "British ship" means a British ship other than an Australian ship; "Foreign ship" means a ship other than an Australian ship or a British ship; "Harbour" includes any harbour properly so called, whether natural or artificial, or any estuary, navigable river, pier, jetty, or other work in or at which a ship can obtain shelter, or ship or unship goods or passengers; "Land Station" means a station, not being a ship station, for the transmission and receipt of messages by means of wireless telegraphy, and includes an experimental station; "Ship Station" means a ship (not permanently moored) having installed thereon appliances for the transmission and receipt of messages by means of wireless telegraphy; "Territorial Waters" means the territorial waters of the Commonwealth and those of any territory of the Commonwealth, and includes harbours; "The Act" means the *Wireless Telegraphy Act*, 1905.

General Licences.—Licences under Section 5 of the Act may be (*a*) General Licences, or (*b*) Experimental Licences.

4. *General Licences.*—(1) A General Licence shall be granted only in respect of ship stations on Australian ships.

(2) Any number of ships belonging to the same company or person may be included in a General Licence.

(3) A General Licence may be in accordance with the form in the Schedule, and shall include the terms and conditions set out in that form.

(4) A General Licence shall be for a period of one year from the date thereof, but may be renewed from time to time.

5. *Experimental Licences.*—(1) An Experimental Licence may be granted in respect of land stations only.

(2) An Experimental Licence shall be in such form and, subject to these regulations, shall contain such terms and conditions as the Postmaster-General thinks fit to include therein.

(3) An Experimental Licence shall remain in force until revoked, or until surrendered by the licensee, but shall be revocable at will by the Postmaster-General.

(4) The wireless telegraphy appliances included in an Experimental Licence shall be used only for experimental purposes, and so as not to interfere with the working of any land station or ship station, and the licensee shall in working the appliances obey all directions issued by the Postmaster-General.

(5) Two land stations may be included in any one Experimental Licence.

6. *Supplementary Licence.*—(1) The Postmaster-General may grant to the holder of a General Licence a Supplementary Licence in respect of any ship belonging to him and not included in the General Licence.

(2) A Supplementary Licence shall be in such form as the Postmaster-General thinks fit, and shall be deemed to be incorporated with the General Licence, and the General Licence shall apply to each ship included in the Supplementary Licence to the same extent as if the ship had been included in the General Licence.

7. *Fees for Licences.*—The fees for licences shall be as follows—

For a General Licence for ship stations or for any renewal thereof—Five shillings for each ship included in the licence.

For a Supplementary Licence for ship stations or for any renewal thereof—Five shillings for each ship included in the licence.

For an Experimental Station—One pound one shilling for each licence for the first year, and seven shillings and sixpence for each succeeding year.

8. *Application for a General Licence.*—(1) An application for a General Licence must be in writing, and must set out the following particulars: (*a*) the names of the different ships to be included therein; (*b*) the ports in Australia at which the ships are registered; and (*c*) the system of wireless telegraphy to be used on the ships.

(2) Before granting the licence the Postmaster-General may require the applicant to furnish such additional particulars as he thinks necessary.

9. *Condition as to Syntony, etc.*—Before any General Licence is granted, the applicant must satisfy the Postmaster-General that the wireless telegraphy apparatus or appliances to be worked in pursuance of the licence complies with the regulations for the time being in force governing syntony and wave length.

10. *Licences to be in Duplicate.*—(1) Every licence shall be made out in duplicate, and one part shall be issued to the Licensee and the other retained in the Department of the Postmaster-General.

(2) Before the licence is issued to the applicant he shall execute the part of the licence to be retained in the Department.

11. *Renewal of a Licence.*—(1) A General Licence or Supplementary Licence may be renewed by writing thereon a memorandum stating the period for which it is renewed.

(2) The memorandum of renewal must be signed by the Postmaster-General or by some officer authorized by him.

(3) The renewal may be made at any time within one month before or one month after the expiry of the licence.

(4) The memorandum is to be written on both parts of the licence.

12. *Revocation of Licence.*—The Postmaster-General may, by notice in writing, revoke and determine any licence, as to all or any of the ship stations included therein, on the ground of the licensee having failed to comply with any regulation for the time being in force under the *Wireless Telegraphy Act* 1905, or on any other ground specified in the licence.

13. *Powers of Inspection.*—The Postmaster-General or any Deputy Postmaster-General or any person thereto authorised in writing by the Postmaster-General or by a Deputy Postmaster-General may at all reasonable times enter upon any ship station or land station on which wireless telegraphy appliances are installed, or are in course of being installed, in pursuance of a licence, and may inspect such appliances and the working and user thereof.

14. *Communications between Ship and Land Stations.*—When communications are made by means of wireless telegraphy between a ship (whether British, Foreign, or Australian) in territorial waters and a wireless telegraph station on land, the rules in force for the working of wireless telegraphy at that station shall be observed.

15. *Application of the Radiotelegraphic Convention and Regulations.*—The provisions of the Radiotelegraphic Convention and the Service Regulations for the time being in force thereunder, so far as such Convention and Regulations are applicable, shall apply to all wireless telegraphy installations available for the transmission or receipt of private messages, whether installed by the Commonwealth or under Licence, and whether at ship stations or land stations, and every Licensee shall comply therewith.

16. *Appliances to be Worked so as to Avoid Interference with other Appliances.*—(1) The wireless telegraphy appliances on board any ship (whether an Australian ship, a British ship, or a foreign ship) in territorial waters shall be worked in such a way as not to interrupt or interfere with—

(*a*) Naval or Military signalling; or

(*b*) the transmission of messages between other wireless telegraph stations.

(2) In this regulation Naval or Military signalling includes signalling or communicating, by means of any system of wireless telegraphy, by the King's Imperial or Colonial Naval or Military Forces.

17. *Appliances not to be Worked while Ship in Harbour.*—Except by permission of the Postmaster-General, the wireless telegraphy appliances on board any Australian ship, British ship, or foreign ship (other than a ship of war) shall not be worked or used whilst the ship is in any harbour in Australia or any territory of the Commonwealth.

18. *Application of Defence Regulations to Foreign Ships of War in Harbours.*—The use of wireless telegraphy appliances on board any foreign ship of war while in any harbour in Australia or any territory of the Commonwealth shall be subject to such rules (whether prohibitive or regulative) as the Governor-General may think fit to make.

19. *Powers of Governor-General in Emergencies.*—If at any time, in the opinion of the Governor-General, an emergency has arisen in which it is expedient that the Commonwealth Government should have control over the transmission of all messages by wireless telegraphy, he may by notice in the *Gazette* prohibit for such period as he thinks necessary the use of wireless telegraphy on board foreign ships in territorial waters.

20. *Control of Appliances in Emergencies.*—(1) In case of emergency, any officer in command of any ship of war of His Majesty's Navy (whether Imperial or Colonial), or any officer in command of any part of the Defence Force, may—

(*a*) take possession of any wireless telegraphy appliances installed on any ship in pursuance of a licence, or installed in pursuance of any experimental licence, and use such appliances for the King's service; or

(*b*) place any person in control of any such appliances; or

(*c*) direct the licensee or person in charge of such appliances to submit to him all or any messages tendered for transmission or received by means of such appliances; or

(*d*) stop or delay or direct the licensee or person in charge of such appliances to stop or delay the transmission or delivery of any such messages or to deliver them to him; or

(*e*) direct the licensee or person in charge of such appliances to comply with all such directions as he thinks fit to give with

reference to the transmission or receipt of messages by means of such appliances.

(2) Every licensee and every person in charge of any wireless telegraphy appliances installed in pursuance of a licence or experimental licence shall comply with this regulation, and all directions issued in pursuance thereof.

(3) Reasonable compensation shall be payable to the licensee for any damage to the appliances arising in consequence of the exercise of the powers conferred by this regulation.

21. *Use of Wireless Telegraphy for Naval or Military Purposes.*—These regulations shall not prevent the use, without licence, by the naval or military authorities of wireless telegraphy for naval or military purposes: Provided that in time of peace each wireless telegraphy installation (other than a mere temporary installation) to be used shall be authorised in writing by the Minister of Defence and notice in writing of the installation shall be sent to the Postmaster-General.

The form of licence set out in the schedule to the above regulations is similar to that employed by the British Post Office. It is laid down in Rule I. that the

"Apparatus shall be deemed to be 'syntonised' when the transmitting apparatus is so adjusted as to communicate with a receiver which has a corresponding adjustment, and to produce as little effect as possible on a receiver not having a corresponding adjustment. The aerial antenna must be continuous and without a break when in the transmitting condition. If two waves are emitted, neither may differ from the normal wave of the station by more than 3 per cent., provided that in the case of stations using 5 kilowatts or over this variation shall not exceed 2 per cent."

Navigation Act

THE Commonwealth Parliament have just passed a new Navigation Act, which contains a clause making it compulsory for ships trading in Australian waters to be equipped with apparatus for wireless telegraphy. This matter is dealt with in Section 236 of the Act, and the text of the section given below is as under:—

EXTRACT FROM NEW NAVIGATION ACT, 1912.

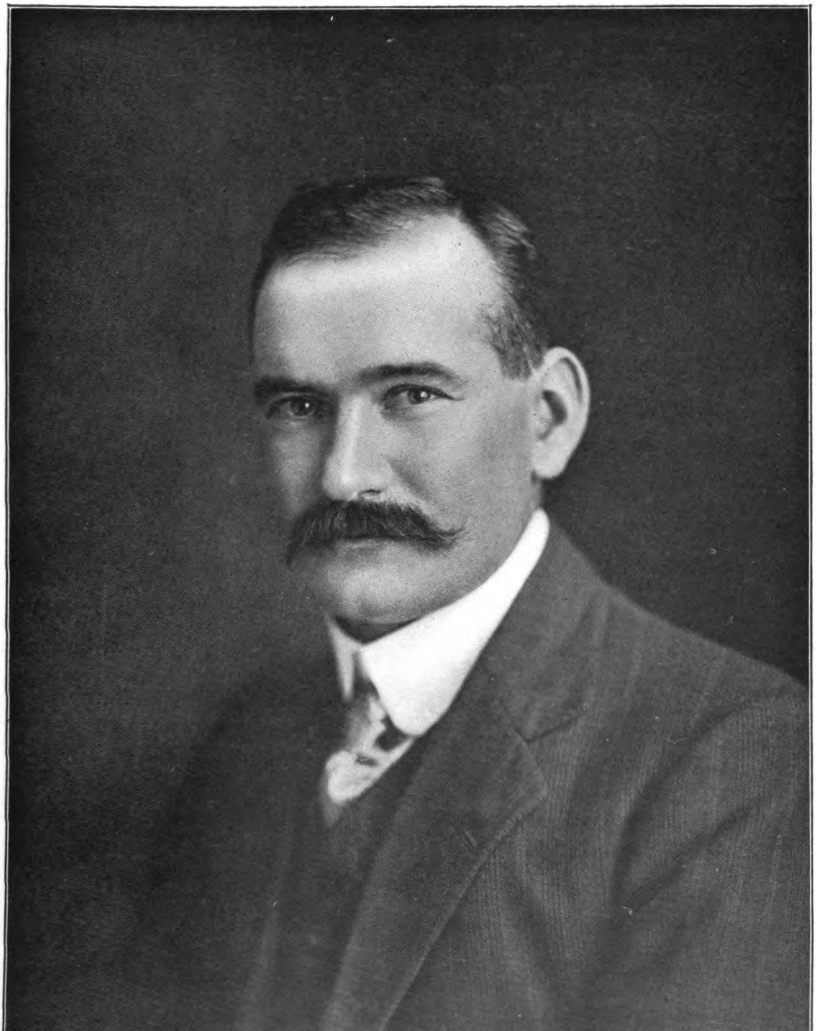
DIVISION VI.—SIGNALS OF DISTRESS.

233 ... ...

234 ... ...

235 ... ...

236 (1) Except as prescribed, every foreign-going ship, Australian trade ship, or ship engaged in the coasting trade, carrying fifty or more persons, including passengers and crew, shall before going to sea from



Hon. C. E. Fraser
(Postmaster-General, Commonwealth of Australia).

[*To face page* 124

any port in Australia be equipped with an efficient apparatus for wireless communication in good working order in charge of one or more persons holding prescribed certificates of skill in the use of such apparatus.

(2) For the purposes of this section apparatus for wireless communication shall not be deemed to be efficient unless :—

(*a*) It is capable of transmitting and receiving messages over a distance of at least one hundred miles, day and night.

(*b*) The person controlling the operator undertakes in writing to the Minister to exchange, and does, in fact, exchange, as far as may be physically practicable (of which the master shall be the judge) messages with shore or ship stations using similar or other systems of wireless communication; and

(*c*) There is provided, in connection with the apparatus, and ready for use whenever from any cause the ordinary supply of electrical power is not available, a battery of accumulators of such capacity as to insure for a period of at least six hours communication of the efficiency prescribed in paragraph (*a*) of this sub-section.

(2a) The equipment shall, if so prescribed, include a silent chamber for the receipt of messages.

(3) The master of a ship required bv this section or the regulations to be equipped with wireless telegraphy apparatus shall not take her to sea, and the owner of a ship required to be so equipped shall not permit her to go to sea, unless the requirements of this section have been complied with.

PENALTY : One Thousand Pounds.

(4) The regulations may prescribe the times and hours during which an operator shall be in attendance on the apparatus, ready to receive or transmit messages.

(5) Except as otherwise prescribed, the provisions of this section shall not apply to ships plying exclusively between ports in Australia less than two hundred miles apart.

In addition to the clauses quoted above, the following new sub-clause was to be proposed by the Minister for Defence in the Senate :—

"The Governor-General may make regulations in accordance with the provisions of any International Convention to which the United Kingdom is a party relating to the use of Wireless Telegraphy on ships, and such regulations may be in addition to or in substitution either wholly or in part for the provisions of this section."

NEW ZEALAND

THERE is no separate Act at present relating to wireless telegraphy in the Dominion of New Zealand, but Part 10 of the Post and Telegraph Act 1908 refers to this branch of communication. Below is an extract from this section of the Act :—

162. The Governor may from time to time establish stations for the purpose of receiving and transmitting telegraph messages within New Zealand or between New Zealand and parts beyond New Zealand by what is commonly known as "wireless telegraphy," including in that expression every method of transmitting messages by electricity otherwise than by wires, whether such method is in use at the time of the coming into operation of this Act, or is hereafter discovered or applied.

163. The provisions of Part VII. of this division of this Act shall, as far as is applicable, *mutatis mutandis,* extend and apply to stations established under this part of this Act, and to communications by wireless telegraphy.

164. Every person who erects, constructs, or establishes any station or plant for the purpose of receiving or transmitting communications by wireless telegraphy without having first obtained the consent of the Governor in Council is liable to a fine not exceeding five hundred pounds, and any plant, machinery, instruments, and material used by him for such purpose may be forfeited and dealt with as the Minister directs.

Part VII. of this division of the Act referred to deals with the construction and regulation of electric lines. It authorises the Governor to establish electric lines and purchase lines and plant. He may make regulations as to the management, working and maintenance of any telegraph. Any officer or person employed in the working of any telegraph who improperly divulges the contents of any telegram transmitted or presented for transmission by such telegraph, or the purport of such telegram, is liable to a fine not exceeding one hundred pounds, or to imprisonment with hard labour for any period not exceeding six months.

FRANCE

AN Official Decree was published in February, 1903, of which the following are the chief clauses :—

(1) The administration of Posts and Telegraphs is alone empowered to establish and work wireless telegraph and postal communication destined for the exchange of correspondence, official or private.

Nevertheless, the various services of the State, after an understanding with the Administration of Posts and Telegraphs, may establish and work directly wireless telegraphy posts destined exclusively for official correspondence.

(2) Communications destined for the exchange of private correspondence may be established and worked by individual and particular parties after authorisation of the Minister of Commerce, Industry, and Posts and Telegraphs, in pursuance of the decree of 27th December, 1851.

The decrees of authorisation will determine the conditions of the establishment and working of these installations.

(3) The Minister of Commerce, Industry, and Posts and Telegraphs is charged with the execution of the present decree.

This decree was accompanied by a statement from the Minister of Commerce, M. Trouillot, who expressed the opinion that the Ministry of Posts and Telegraphs was best qualified to take in hand the organisation of the wireless telegraph services, because that department knew the needs of the public, it knew how to adapt itself to the commercial exigencies it would have to satisfy, and it, alone, possessed servants with the experience necessary to manipulate the very delicate apparatus of Wireless Telegraphy.

For the rest, the Minister pointed out the importance of the fact that the Administration of Posts and Telegraphs was alone qualified to regulate the exchange of wireless communications with foreign countries. He concluded thus:—

"In brief, the similarity in working between wireless and electric telegraphy, the aid they must mutually lend one another, the analogy in the results, and the intimate connection of the new system with the submarine telegraphy, the interests of commerce and navigation, the interpretation constantly applied of the laws of 2nd May, 1837, and 27th December, 1851, all go to prove that the Ministry of Posts and Telegraphs should take over the working of the new method of transmission, and, in consequence, the business of insuring in this particular case, as in all the others, the practice of a telegraphic monopoly."

GERMANY

Sole Article:—The Act of April 6th, 1892, relating to telegraphs in the German Empire is modified as follows:—

1. Article 3 is completed by the following Paragraph 2:

Installations of electric telegraphs for transmission of messages without the aid of metallic wires of junction, shall not be

established and worked, except with the authorisation of the State.

2. The following provisions are inserted after Article 3:

(3 *a*) Telegraphic installations which are not exclusively designed for the internal service of a ship, cannot be established and worked on German vessels, unless authorised by the State.

(3 *b*) The Imperial Chancellor shall decree the regulations concerning the working of telegraphic stations on board foreign vessels in German territorial waters.

3. Article 7 is completed by the following paragraph (2):

The provision of Paragraph 1, Phrase 1, does not apply till July 1st, 1913, to installations of the nature defined in Article 3, Paragraph 2.

The following regulations are decreed for the working of telegraphic installations on board foreign ships in German territorial waters, and are founded on Article 3 (*c*) of the "Telegraph Law of the German Empire" of April 6th, 1892, and March 7th, 1908, and under the reservation of Article 15 of this law:—

1. Ships of war are authorised, in a general manner,

(*a*) To exchange messages, signals, by means of optic and acoustic signals, submarine acoustic signalling excepted.

(*b*) To use wireless telegraphy, on condition that they do not disturb the radiotelegraphic service of the public coast stations, or the service of the coast or ship stations of the Imperial Navy.

In exchanging messages with German or foreign radiotelegraphic stations, foreign vessels must conform to the regulations of the "Decree for the Regulation of the Radiotelegraphic Service" and to the Decrees which may ultimately be promulgated.

2. Foreign vessels other than ships of war are authorised—till otherwise decreed—

(*a*) To exchange messages by means of optic and acoustic signals, submarine acoustic signalling excepted, and under the reservation that within the illumination zone of the navigable waters of the German coasts and islands the lights of the signal projectors or lanterns must not exceed that prescribed for fixed lights.

(*b*) To use wireless telegraphy in conformity with the provisions of the "Decree Regulating the Radiotelegraphic Service" and the decrees which may ultimately be promulgated; nevertheless, in the ports, roadsteads, and estuaries, and in the navigable waterways of the interior, wireless telegraphy can only be used on an authorisation being granted in writing by the Ministry of Posts and Telegraphs of the German Empire.

3. In the public interest the Articles 1 and 2 may be temporarily restricted or suspended.

4. Whosoever works telegraphic installations in a way not authorised by the preceding provisions is liable to fines determined in Article 9 of the "Law of Telegraphs," and in virtue of Article 40 of the Penal Code of the German Empire, all the apparatus designed for the transmission of wireless messages can be confiscated. Moreover, installations which have been worked without a licence can be, in conformity with Article 11 of the "Telegraph Law," removed or rendered unserviceable.

ITALY

THE following regulations (No. 227) were published in April, 1912, for carrying out the Act of June 30th, 1910 (No. 395):—

1. The Ministry of Posts and Telegraphs shall have under its control:—

Section I.

(*a*) The installation and exploitation of the stations for public service and constituting the interior net-work of the State and of all those opened for international communication.

(*b*) The verifications, inspection and control of the material and working of the service of all the land installations exploited in virtue of Government licence.

(*c*) The tariff regulation for communication between all land stations and ship and shore stations, also accounting.

The Ministry of War shall have under his control:—

(*a*) The installation and working of stations destined exclusively to the military service, including movable field stations for use in the R. Army. In time of war the management of the service (either a part or all the stations destined to the public service) can be taken over by the military administration.

The Admiralty shall have under its control:—

The installation and exploitation of the ship stations of the Royal Navy, private and mercantile; the verifications, inspections and control of the materials and of the working of the service of the installations made for passenger and mercantile traffic.

Section II.

2. *Permanent Consulting Radiotelegraphic Commission.*—The Permanent Consulting Commission is composed of a President not belonging to the Government Administration, two members selected amongst persons of well-known ability in electric and radiotelegraphic science, a superior officer of the Royal Navy attached to the General Staff, and a superior officer attached to the office of the Chief of the General Staff of the Royal Navy.

The following are members of the Commission by right:—

(1) The Director of Posts and Telegraphs Higher Institution.

(2) The Director in Chief of the Radiotelegraphic Department of the Posts and Telegraphs.

(3) The Officer-Director of the Radiotelegraphic Department in the Army Office of Rome.

(4) The Superior Officer of the General Staff of the Royal Navy, Chief of the Department of the Submarines, Electric material and Radiotelegraphic Service at the Admiralty.

Three members, selected amongst the three mentioned Administrations, will act as Secretaries.

3. The President, members and secretaries will be nominated by Royal Decree, proposed, by common accord, by the Ministers of the Posts and Telegraphs, Admiralty, and War.

By Ministerial decree extraordinary members, without vote, can be added temporarily, these to be selected from persons of well-known skill, proposed by the President of the Commission.

4. The Commission shall have its office at the Admiralty in Rome. The meetings of the Commission are to be convened by the President at the request of the interested Administrations.

5. The opinion of the Consulting Commission can be asked on the following subjects:—

(*a*) On the compilations of arrangements and special rules for the technical organisation of the radiotelegraphic and radiotelephonic service of the State, as well as for practical rules for the constitution and exploitation of the installations.

(*b*) On all questions of a scientific nature, and doubtful cases referring to the radiotelegraphic and radiotelephonic services.

(*c*) On International Conventions.

(*d*) On technical conditions with reference to licences of radiotelegraphic and radiotelephonic stations.

(*e*) The establishment, before granting the licence, of indemnity due in case the installation should be repealed, suspended, or taken over by the State according to paragraph III., Art. I. of the law.

(*f*) Repeal of the licences.

(*g*) On the adoption of new radiotelegraphic and radiotelephonic systems, and on the application of same by the Government service, unless they should deal with interesting systems concerning the defence of the State.

The qualified Administrations may whenever they think it warranted ask the opinion of the Commission on any subject.

The Commission is entitled to avail itself for its own study of the working rooms and of the Government experimental stations, but a previous application must be lodged with the Administrations.

6. The expenses for the working of the Commission are to be divided amongst the three Administrations interested.

Section III.

7. *Licences for the Exploitation of Radiotelegraphy and Radiotelephony.*—Licences to persons, to institutions, and to public and private Administrations for the installation of any radiotelegraphic or radiotelephonic station will be granted in virtue of an agreement containing the conditions to be observed, by a decree issued by the Ministry of the Posts and Telegraphs, acting in harmony with the Ministry of War and the Admiralty.

Such licences cannot last longer than the 16th February, 1917. After this period the licence can be renewed.

8. Licences for radiotelegraphic stations for private use are limited to private correspondence between properties of the same licensee or between properties of two licensees, all correspondence with third persons being absolutely excluded. Such licences are exempted from tax when the stations are constructed on private property and work over all the territory dividing the stations, without interruption by public land.

Licences are also exempted from taxes which are granted for installation of radiotelegraphic and radiotelephonic stations having for object a scientific or educational purpose.

9. All applications for licences for radiotelegraphic and radiotelephonic installations must contain :—

(*a*) The exact indication of the person or institution making the application and their legal residence.

(*b*) The nature and purpose for the licence, the place or places where it is proposed to instal the station or stations, and their presumed zone of service.

(*c*) The detailed plans for the construction and technical quality of the installation, indicating in a detailed manner the nature and power thereof.

(*d*) The period for which the licence is asked.

(*e*) The period required before starting the station.

(*f*) The receipt of the amount to constitute the deposit-guarantee, as per Art. 13 and 14.

Such a deposit must be paid to the cashier of the local Provincial Direction of Posts and Telegraphs by the applicant for the licence.

10. Every contract by the licensee, having for object the hire, amalgamation, partial or complete transference of the licence or licences, cannot take place before obtaining in advance the approval of the Government.

11. The licence is considered as expired should the licensee fail to complete and have ready for service the radiotelegraphic or radio-

telephonic installation within the time stipulated as per paragraph (*e*) Art. 9.

The licence is considered as expired on the death of the licensee.

12. The officials of the State Telegraphic Administration shall be responsible for the maintenance of the installation and proper up-keep of the radiotelegraphic and radiotelephonic land stations for which a licence is granted; they shall satisfy themselves that the licensee observes the law and the present regulations and that the licensee fulfils all the obligations imposed upon him by his contract with the Government.

13. Every licensee for radiotelegraphic or radiotelephonic installation for private use, excepting the cases considered in Art. 8, will pay in advance to the State an annual fixed tax of £It.50.

To guarantee the said tax the licensee must make a deposit as guarantee equal to the amount of fixed tax for one year.

14. Every licensee for radiotelegraphic or radiotelephonic installations for public use will pay every year to the State in quarterly instalments a tax corresponding to 10 per cent. of the revenue from radiotelegraphic or radiotelephonic charges on the basis of the common tariff.

To guarantee the said tax the licensee will make a deposit as guarantee of not less than £It.200. If after one year the guarantee shows to be less than the amount due to the State for one year, then the deposit must be brought to the level of such proportion.

15. The period of the licence and the obligation of the tax established by Articles 13 and 14, begin from the month following the decree granting the licence.

16. The deposits as per Articles 13 and 14 will be forfeited to the public exchequer in case of withdrawal or termination of a licence.

Should the licensee fail to provide for the payment of the taxes due as per Articles 13 and 14, the Government will apply the deposit, which should be increased in its integral amount within ten days of the said confiscation.

Section IV.

17. *Qualifications for the Radiotelegraphic and Radiotelephonic Service.*—The staff necessary for the management and working of the radiotelegraphic and radiotelephonic service is appointed as follows:

(*a*) For the stations under the control of the Ministry of Posts and Telegraphs, from amongst the officials of specialists of first, second, third and fourth class.

(*b*) For the stations under the control of the Ministry of War, amongst the officers and privates of the engineers of the R. Army.

(*c*) For the stations under the control of the Admiralty, from amongst the officers of the staff and the marines.

Should it at any time be found convenient to the management and working of the above-mentioned stations, a mixed staff selected from the three Administrations can be employed.

The Ministry of the Posts and Telegraphs can for an educational purpose always send its own staff to the radiotelegraphic and radiotelephonic commercial stations by making previous arrangements with the interested Administration.

18. The staff to be employed in the radiotelegraphic stations licensed to private persons must possess a certificate proving their professional ability.

Such a document is granted either by the Ministry of Posts and Telegraphs, or by the Admiralty, according to the service for which it is intended.

Section V.

19. *Limitations to the use of Radiotelegraphic and Radiotelephonic Apparatus.*—Cargo and passenger vessels are prohibited from using their own radiotelegraphic or radiotelephonic stations when they are at anchor in the State waters, except in cases of giving warning of danger or appeals for help, or when they are about to sail, or for urgent reasons within an half an hour after their arrival and when the communication with the land is cut off for special reasons or for sanitary measures.

A breach of this rule will render the transgressor liable to the penalties imposed by Article 3 of the law.

Section VI.

20. *Taxes.*—The land tax for one radiotelegram is composed:

(*a*) Of the radiotelegraphic tax due to the coast station;

(*b*) Of the radiotelegraphic tax due to the station on board;

(*c*) Of the telegraphic tax.

For taxation purposes only those radiotelegrams exchanged with Board stations are considered.

21. All the radiotelegraphic and radiotelephonic stations installed before the promulgation of the law must apply for a licence within one calendar month of the present regulation.

The following is known as the Law of 30th June, 1910, No. 395:—

Art. 1.—The establishment and exploitation of the radiotelegraphic and radiotelephonic installations are reserved to the Government, and in general of all those for which, in the State and in the Colonies, on land and on board ship, energy is employed in order to obtain distance effects without the use of conducting wires.

The Government has the right to grant to any person, public or private scientific or training institution, the authority to establish and to exploit installations of such a nature on land and on the pas-

senger and mercantile vessels, for which previous concession must be obtained.

The licence may be revoked upon the recommendation of the consulting Commission when the installations cause interruption of State stations which were in operation prior to the concession, or when they do not comply with the technical conditions established in the licence.

The exploitation of the installations granted can be revoked, suspended, or taken over by the Government in time of war or during peace whenever the Government may deem it necessary and opportune.

The Government has also the right to inspect, through its officials, those stations which are not the property of the State, in order tc ascertain whether the stations are operated in accordance with the regulations.

Art. 2.—The Government administrations concerned in these services are the Ministry of Posts and Telegraphs, of War and the Admiralty; and special regulations determine the share of the respective departments in the execution of the present law.

A permanent consultive commission is constituted to give opinions upon international agreements, questions of a scientific nature, and upon doubtful points relating to the said services.

The commission shall also decide every doubtful case which may arise of a technical character regarding the installation and exploitation of the concessions according to Art. 1.

The commission shall be qualified to determine the power of the radiotelegraphic and radiotelephonic apparatus and technical and economic details for their use on vessels engaged in emigration traffic, when the said apparatus has been installed by the Government according to Art. 11 of the Royal Decree, 14th March, 1909, No. 130.

Questions concerning indemnity on account of the cancellation of a licence, suspension of exploitation, or redemption as per Art. 1, shall be referred to an arbitration tribunal, which shall decide, without right of appeal. This tribunal shall be composed of three members, one nominated by the Government, one by the licensee, the third by the President of the Tribunal in Rome. The Government can leave to the said Commission the selection of its own arbitrator.

Where several licensees are interested parties to a dispute, and they are unable by mutual agreement to nominate an arbitrator, each shall submit the name of an arbitrator, and the choice will be made by drawing lots in the presence of a judge of the Tribunal of Rome.

The composition of the Commission in the present article and the rules of its working have been determined in the regulations.

Art. 3.—Every infringement of Art. 1 of the present law is punishable by a fine up to £ It. 2,000, and with imprisonment up to one year, which penalties may be imposed separately and together according to

the circumstances. It is in the power of the judge to add to the said penalties the confiscation of the apparatus.

During criminal proceedings the Administration can, in virtue of decree by the prefect, and at all times that in the opinion of the prefect would be in the public interest, obtain immediate possession of the installation and provide if necessary for its removal.

Any person will incur the same penalties if he should avail himself of the installation on board commercial or passenger vessels when they are at anchor in the State waters, except in case of danger or other special cases, which will be dealt with in the regulations.

Art. 4.—If any person should cause damage or deterioration to installations, or in any other manner interrupt, or cause interruption of the service, even temporarily, he will be liable to the penalties laid down in Art. 315 of the Penal Code, except in the case of military interference with military stations, for which offence the penalties stated in the Penal Code will be imposed.

If any person should abuse the use of the alarm signal of the vessels in danger, he will be subject to the same penalties.

Art. 5.—The penalties established by the present law are understood to be applicable, without prejudice, to greater offences which may take down in Art. 315 of the Penal Code, except in the case of military Penal Code.

AUSTRIA

The following Decree of the Ministry of Commerce, dated 7th January, 1910, is concerned with wireless telegraph stations in the Austrian Empire, on board Austrian ships, and on ships of foreign nationality in Austrian territorial waters:—

(1) In accordance with a High Decree of Parliament of January 16th, 1847, and the Decree of the Ministry of Commerce, dated April 28th, 1905, the erection and working of Wireless Telegraph stations in the Austrian Empire and on Austrian ships is a State concession, to acquire which a written application (liable to Stamp Duty), containing a description of the station and a diagram of connections, must be submitted.

(2) The choice of system, apparatus, and fixtures, as well as the establishment of coast and land rates within the limits of the Wireless Telegraph agreement of 1909, and the supplemental regulations are the prerogative of the Ministry of Commerce.

(3) The general regulations for Wireless Telegraph stations on board ships are shown below.

(4) Wireless Telegraph stations on board ships must fulfil the following conditions:—

(*a*) They must be of equal technical efficiency to systems other than that adopted in the stations, and they must be able to inter-communicate with other systems.

(*b*) The system adopted must be one of "syntonisation."

(*c*) The speed of transmission and reception must not, under normal circumstances, be less than twelve words (each of five letters) per minute.

(*d*) The power possessed by the apparatus must not exceed, in normal conditions, 1 kilowatt. A greater power can be used when the ship is under an obligation to exchange news at a longer distance than 300 kilometres from the nearest coast station, or when the transmission can only be effected by means of a higher power than specified.

(5) The working of Wireless Telegraph stations on board ships of foreign nationality in Austrian territorial waters is dependent upon the previous grant of a State concession. This regulation does not apply to war-ships or ships in distress. If a ship of foreign nationality uses its Wireless Telegraph station without authorisation, the State authorities may take steps to hinder the working of the station in Austrian territorial waters.

The following Regulations of the Ministry of Commerce dated March 1st, 1912, concern the erection of a wireless telegraphy inspectorate in Trieste, and the erection and regulation of wireless telegraphy offices on Austrian vessels.

(1) In accordance with the High Decree of 15th February, 1912, a Royal Wireless Telegraphy Inspectorate has been created, which is immediately subordinate to the Ministry of Commerce. Comprehended in this Directorate are the Wireless Telegraph offices on board Austrian ships, and, in addition, private Wireless Telegraph offices on Austrian ships and on foreign ships in Austrian territorial waters come within its jurisdiction.

The directorate commences its activity in April, 1912.

(2) The following "Normal Regulations as to the Installation and Working of Wireless Telegraphy Offices on Board Ships" were published and came into effect on 1st April, 1912.

(3) The Ministry of Commerce will, in accordance with the Decree of 7th January, 1910, concerning the regulation of Wireless Telegraphy in the Austrian Empire, on Austrian ships, etc., only grant future concessions for the installation and working of Wireless Telegraphy offices on board Austrian vessels in those cases in which such installation and working of a Wireless Telegraphy office on board ship has been refused by it.

Regulations.

The following normal Regulations governing the installation

and working of wireless telegraph offices on board Austrian ships came into force on April 1st, 1912:—

(1) Wireless Telegraph offices on board ships under the State direction shall carry the sign "Kk Bordtelegraphamt" (Royal Telegraphy Office on Board Ship), together with the name of the vessel.

(2) The owner of a vessel who requires a Wireless Telegraph office must apply to the Ministry of Commerce, and must give the following particulars:—

(*a*) The name of the ship and the time and date when the installation is required to be erected.

(*b*) The routes on which the ship will be principally engaged.

(*c*) The accommodation for first and second-class passengers on board.

(3) The Ministry of Commerce must, within a period of two months, inform any applicant for a Wireless Telegraph installation on board ship whether such an installation will be granted, and, if so, upon what terms.

Provided the vessel on which it is proposed to instal a Wireless Telegraph office comes within the scope of the Decree of the Ministry of Commerce, dated November, 1910 (concerning the equipment for Wireless Telegraphy of long-voyage passenger ships) the Ministry of Commerce must grant any application made in accordance with these regulations.

In cases where the Ministry declines to grant an installation, it is not called upon to state any reasons for its refusal. A written agreement is in all cases drawn up between the State Department and the owner of the vessel when an installation is granted.

In the event of any change in the regulations, a new agreement must be made.

(4) The Wireless Telegraph office shall be installed as near as possible to the date required by the shipowner, provided the application sent has duly satisfied the conditions laid down in Regulation 2. The period during which the installation is granted is usually six months.

The State department shall bear the entire cost of the fitting and furnishing of the Wireless Telegraph office, which is to remain the property of the State. The department shall undertake to maintain the office in a state of efficiency and to supervise the working of the installation through its own servants.

(5) The shipowner shall be responsible for the cost of all arrangements on board, services of the ship's *personnel,* materials and plant necessary for the proper installation and working of the Wireless Telegraph office, as well as the necessary electric power.

The shipowner's obligations with regard to these arrangements are set forth in detail in the written agreement referred to in Regulation 3.

The shipowner shall be required to provide adequate facilities for the telegraphists on board, to enable them to carry out their duties in an efficient manner; and the telegraphists must be made acquainted with the course and speed of the ship, soundings, and distances from foreign stations, as well as meteorological data.

(6) The shipowner must pay the salaries due to the telegraphists for each voyage, which amounts thus paid will be refunded by the State, who will inform the owner, before the departure of the vessel, the amount of salary due to the telegraphists and the dates when the salaries become due.

The owner of the ship must make suitable provision for the safety of the telegraphists on board.

The owner must, at his own cost, carry out the following duties:—

(*a*) Convey telegraphists of the Royal Austrian Navy between Pola and Trieste when ordered to transfer them to or from the Wireless Telegraph Inspectorate at Trieste.

(*b*) Transfer the ship's telegraphists between the port and the ship which is being equipped with a Wireless Telegraph office, or between two ships, and provide for the maintenance of the telegraphists during the transfer.

(*c*) First-class travelling expenses and maintenance of the chief officials of the Royal Telegraph Department shall be provided when the officers are proceeding to take up their duties. Second-class travelling expenses shall be provided for officers of lower rank.

(7) The shipowner must contribute to the State Department an annual sum for the cost of the Wireless Telegraph office on board. In the case of ships which come under the decree of the Ministry of Commerce dated November, 1910, the amount which the shipowner must contribute is from Kr. 2,200 to 2,500 (£1,100 to £1,250)—the amount depending upon whether the apparatus is of the first or second-class type. The Ministry of Commerce will decide under which class the apparatus comes. The annual amount is payable in advance, in instalments, which become due on the first day of the months January, April, July, and October. The liability of the owner of the vessel becomes due on the date when the Wireless Telegraph office on board commences operations, and ceases on the date of the closing of the office; but in any case not before the expiration of the term of notice.

If the ship should be lost, the obligation to contribute ceases on the date of the loss, and when this is not known, the obligation is dated from the last date on which the ship was heard.

When a vessel has received through its Wireless Telegraph office distress messages from other ships, and has thus saved or helped to

save another ship, the owner must pay to the State Department 3 per cent. of the net sum received by him for salvage.

(8) Service messages to and from the owner of the ship are dealt with at ordinary rates; "shipowner telegrams" which are wireless telegrams transmitted by the captain of the ship to the owner, or to the managing officials or agents, and which deal with the crew, passengers, cargo condition, voyage, conduct, or damage of the ship, are not transmitted in the interests of a third person.

"Ship Service Telegrams" are wireless telegrams exchanged by the captains of ships under the same ownership. Both classes of telegrams must be composed by the senders, and code words must be used as far as possible. A copy of the code must be deposited on board ships that have to transmit shipowner and ship service telegrams, and likewise in the office of the department. Such telegrams must be written by the sender on a form having a detachable receipt coupon provided for the purpose. They are only transmitted when the receipt coupon has been impressed with the ship's stamp, and this stamp must agree with the stamp which is deposited by the commander of the vessel in the wireless telegraph office on board.

(9) The coast and land charges for shipowner telegrams are deferred and are fixed on the basis of the receipt coupon in the wireless office on board. These charges must be checked immediately after the arrival of the ship in her own port against the amount of the receipt in the wireless telegraph office on board.

The charges for private telegrams may be collected in cash by the officer in charge of the wireless telegraph office, at the time of the despatch of the telegram, or they may be placed to credit.

(10) Telegraph operators on board are subject to the general discipline of the ship, and to the instructions of the captain or his representatives. They must not, however, be called upon to participate in any of the ordinary business of the ship.

Free access to the premises of the telegraph office is allowed to the captain or to his representatives. Other members of the crew may have access to these premises only for the purpose of executing the duties mentioned in Regulation 5.

A member of the crew must be sufficiently competent to take the place of the operator in case of necessity, and before the beginning of the voyage the person so appointed must be sworn to secrecy in the usual way.

(11) The State shall provide a Wireless Telegraph office on board ship when it deems it necessary for a definite or indefinite period, and in this case the owner has no claim to indemnity.

In the case of mobilisation or war the embargo on the Wireless Telegraph office of a ship can be ordered by the Royal Austrian Navy or by a Royal Austrian Consulate.

The captain of a ship is responsible for the closing of a telegraph office when such an order proceeds from the authorities mentioned.

(12) The State may at any time create a Wireless Telegraph office on a ship not limited to the decree referred to in Regulation 3. The owner of the ship must receive not less than six months' notice of the intention to create such an office; but, where circumstances warrant it, this period of notice shall not be observed.

The owner must give six months' notice in writing of his intention to terminate the agreement referred to in Regulation 3, and in the case of the sale of the ship three months' notice.

After the expiration of the notice the Wireless Telegraph office will be dismantled (except in the case of the ship sold abroad), but the dismantling shall take place only when the ship is in an Austrian port.

In the event of the dismantling of the office taking place in a port other than that of Trieste, the shipowner must pay for the technical dismantling and material belonging to the State, and he must despatch the apparatus to Trieste at his own cost, and pay the fares of the telegraph operators to the last-named port.

Document of Concession.

The Ministry of Commerce hereby grants to .... the concession for the installation and working of a wireless telegraph ship station on board the s.s. .... and reserves to itself the right to cancel same at any time. The concession is granted on the following conditions :—

(1) The Wireless Telegraph station must be erected according to the description in the application and according to the diagram of connections.

Supplemental changes in the technical installation which would have an effect upon the transmitting and receiving speed of the station cannot be undertaken without the consent of the Ministry of Commerce.

(2) The concessionnaire must pay an annual recognition fee of 20 Kronen for the station.

(3) The Telegraph Directorate is entitled to empower their officials to examine the station and to control the working of the same.

Opportunity must be given to officials of the Austrian Navy, on their request, to make themselves acquainted with the working of the station apparatus.

Collusion in order to keep back details of the condition of the station from the official authorities is inadmissible.

(4) The Telegraph Directorate reserves to itself the right of using the station at any time, completely and absolutely, or for a

definite kind of correspondence, and this they may do without giving their reasons, or without the concessionnaire being able to claim any indemnity.

(5) In case of war and mobilisation the station must be closed. The commander of the ship must superintend the closing and make himself responsible for it.

The control over the supervision of this measure is confined to the military authorities.

(6) Only Austrian subjects can be employed as telegraph operators, and they must be able to show a testimonial to the effect that they have successfully passed the special examination of the Telegraph Directorate.

Wireless telegraph operators on board ship must be provided with a sea service book, they must be enrolled in the muster, and must be subject to the ship's discipline.

In case of the cancelling of the above-mentioned testimonial by the State Telegraph Directorate, a telegraph operator must be dismissed immediately.

Every change of operator must without delay be notified to the marine authorities in Trieste.

(7) The concessionnaire must allow to third persons the services of the station on payment by them of the normal charges.

(8) The station charge amounts to . . . a word. The lowest telegram amounts to . . . Kronen. The charge belongs to the underwriter.

(9) The station must exchange news with all coast stations, and with all other ship stations without prejudice as to the system of wireless telegraphy used by these stations.

(10) As regards the working of the station and the scale of the tariff, the regulations of the International Wireless Telegraphy Agreement of Berlin and its supplemental regulations must be observed, in the same manner as all measures published by the Telegraph Directorate.

The call signal of the station is established as . . . .

RUSSIA

THE following Statute and regulations have been adopted for the institution of an inter-departmental Radiotelegraphic Committee :—

STATUTE.

1. To establish the attached regulations concerning an inter-departmental Radiotelegraphic Committee and the necessary personnel.

2. To make Paragraph 1 effective as from July 1st, 1912.

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3. To allot for the expenses of the said Committee (13,200 roubles annually) from the Imperial Treasury commencing from the year 1913 and to debit the expenses for 1912 (amounting to 6,600 roubles) to the anticipated surplus on the estimates for 1912.

REGULATIONS.

1. An inter-departmental Committee is instituted for the co-ordination of the work of the various departments relating to the existence and use of the Imperial network of radiotelegraphic and radiotelephonic stations and for the consideration of schemes for the establishment and maintenance of radiotelegraphic and radiotelephonic communication which require preliminary discussion between the departments affected thereby.

This Committee is attached to the Headquarters Staff of the Postal Telegraph Department.

2. The Committee shall consist of a President and of permanent members appointed by the Ministries of the Interior of War, Routes of Communication and of Foreign Affairs. When schemes for the establishment and exploitation of radiotelegraphic and radiotelephonic stations for the use of the Ministry of Finance or other departments are under consideration representatives of the department in question shall be appointed to attend the meetings of the Committee and have the right to vote.

When legal aspects of radiotelegraphic and radiotelephonic communication are under discussion a representative of the Ministry of Justice shall be invited to attend and shall have the right to vote.

The Ministries of the Interior, of War, of Marine, of Routes of Communication and of Commerce and Industries shall each appoint two members to the Committee and the Ministry of Foreign Affairs shall appoint one member.

3. When necessary the Ministry of the Imperial Court shall appoint two representatives to attend the meetings of the Committee and the Ministry of Justice or other Ministries shall each appoint one member.

In the event of the representative of any of the Ministries being unable to attend the meetings of the Committee the Ministry in question may appoint a temporary substitute.

4. The President of the Committee and one of the permanent members of each department that furnishes two members must have special scientific and technical knowledge, and any temporary substitute appointed to represent these must be in possession of the same qualifications.

The President of the Committee shall be appointed by His Imperial Majesty on the recommendation of the Minister of the Interior and the members of the Committee.

Understudies need not be of equal rank with the members for whom they act as substitutes.

During the absence of the President the fulfilment of his duties shall devolve upon one of the members appointed by the Ministry of the Interior.

5. The duties of the Committee are as follows:—

(*a*) The examination of schemes which have been worked out by the various departments for radiotelegraphic and radiotelephonic installations with the object of co-ordinating them and of fitting them into a general plan for a network of radiotelegraphic and radiotelephonic stations throughout Russia.

(*b*) The regulation of the mutual relations between the radiotelegraphic and radiotelephonic stations of different departments during their operations.

(*c*) The examination of matter relating to communication between ship and shore stations.

(*d*) The consideration of proposals made by various departments for the issue of new laws, rules and regulations concerning radiotelegraphic and radiotelephonic communication.

(*e*) The preparation of materials and questions to be brought forward by Russia for discussion at International Radiotelegraphic and Radiotelephonic Conferences.

(*f*) The drafting of general technical regulations, rules and standards relating to radiotelegraphic and radiotelephonic installations.

(*g*) The investigation of the general requirements of Russia in the matter of specialists in radiotelegraphy and telephony, and in the matter of their education and of the right to radiotelegraphic and radiotelephonic communication.

(*h*) Action as consultants in connection with questions concerning radiotelegraphic and radiotelephonic communications which may be referred to the Committee by various departments and particularly the examination of and reporting upon the practical value of new inventions relating to radiotelegraphy and radiotelephony.

(*i*) All other matters and questions concerning radiotelegraphic and radiotelephonic communication.

6. All matters and questions relating to radiotelegraphic and radiotelephonic communication enumerated in Sections *a* to *e* and *h* of the preceding paragraph (5) shall be brought forward by the various departments for the decision of the Committee.

Matters indicated in Sections *f*, *g* and *i* of the same paragraph shall be examined by the Committee either on their own initiative or at the request of the departments interested.

7. Matters shall be submitted to the Committee in accordance with the instructions and resolutions of Ministers or Commanders-in-Chief in a complete form and with a definitely worded request from the department.

8. Communications between the President of the Committee and the Senate or the Chiefs of Headquarters or Chiefs of departments or their subordinates or Governors shall be made in accordance with Clauses 233-236 of the Institution of Ministries.

9. For the preliminary technical consideration of complicated affairs the Committee shall be empowered to appoint, when required, special sub-committees consisting of members of the Committee who are particularly concerned in the matter and of well-informed persons who may be invited by the Committee and who will have the right to vote at the meeting of the sub-committees. At such meeting a member chosen by the Committee will preside.

10. For the carrying out of scientific and technical researches the Committee shall be permitted to use the laboratories of the Chamber of Weights and Measures and of other institutions in St. Petersburg, under conditions to be defined by special agreement between the Ministry of the Interior and other Ministries.

11. The final preparation and presentation of affairs to the Committee will be performed by one of the permanent members. Matters of a departmental character will be presented by a representative of the Ministry responsible for bringing the matter before the Committee for consideration.

12. The Committee will meet, by order of the President, at the Headquarters of the Postal Telegraph Department, not less than once per month, with the exception of the summer holiday season, when meetings will be convened as required.

13. To form a quorum at meetings, the attendance is required of the representatives of the department which has introduced the business under discussion, and of at least one permanent member each from the Ministries of the Interior, of War, of Marine and of Commerce and Industries.

14. All affairs in the Committee shall be decided by a simple majority of votes, each department having only one vote through its representatives. At meetings of sub-committees questions shall be decided by a simple majority of votes of all members of the sub-committee, including experts who may have been invited to attend the meetings.

In case of the votes of two parties being equal, the President shall give the casting vote.

15. In case of a department disagreeing with a decision of the Committee, the latter may, if they consider it necessary, refer the matter to the Council of Ministers.

16. In connection with each matter examined by the Committee a short protocol must be prepared and signed at the same meeting by all members of the Committee who are present. Independently of the protocols detailed journals of the meetings will be kept and these will include the opinions of the Committee concerning the business under consideration. In case of a division of votes the protocol and the journal must contain the opinions both of the majority and the minority, together with a statement as to the Ministries which were included in each party.

17. The originals of journals and protocols will be kept with the documents of the Committee, but copies of the journals must be communicated within seven days to the Chiefs of Headquarters and to Chiefs of sections of those departments which are represented on the Committee.

18. The procedure to be followed in bringing matters before the Committee must be decided by the Committee and confirmed by the Minister of the Interior by agreement with other Ministers concerned.

19. The secretarial work in connection with the Committees shall be carried out by the secretary of the Committee, by his assistant, and by the officials allotted for the clerical work of the Committee.

20. The Secretary of the Committee shall be chosen by its President, whose choice must be confirmed by the Minister of the Interior. The appointment of the assistant secretary is confirmed by the President of the Committee. Only persons who have received a University education and who have a technical knowledge of radiotelegraphy and radiotelephony will be qualified to hold such posts.

The following are the principal provisions of the Decree concerning wireless telegraphy in Russia of February 20th, 1908:—

By a "radiotelegraphic station" is understood every installation designated for telegraphic communications and capable of producing on the spot or receiving from a distance electro-magnetic waves.

Stations of this kind comprise:—

1. Stations designated for a special use.
2. Stations designated for a general use, that is to say, open to accept telegrams from the public.

The form of administration, working, and supervision of radiotelegraphic stations are regulated by the personnel of the Telegraph Service, except in the case of the special and supplementary provisions to be eventually fixed.

The establishment of radiotelegraphic stations for public use and the general management of the Radiotelegraphic Service of the Empire are under the jurisdiction of the General Direction of Posts and Telegraphs, to which likewise belongs the direction of the establishment of the aforesaid stations by the various Government departments, with

all questions affecting their destination, power, range, and technical construction.

The carrying out by scientific associations and schools of public instruction of scientific experiments and researches in radiotelegraphy is subject to an authorisation, by special request, of the Minister for the Interior. These experiments, as well as the working of radiotelegraphic stations for purposes of instruction, can be interdicted in cases where such experiments and instructions would exercise a harmful influence on neighbouring radiotelegraphic stations, or, in general, prejudice the interests of others.

Stations on board ships anchored in ports, or sailing near the coasts, are subjected to special regulations decreed by the Minister for the Interior in common accord with the Ministers of War, of the Marine, of Ways and Communications, of Foreign Affairs and of Commerce and Industry.

DENMARK

The following regulations became effective on February 1st, 1909:—

Publication concerning the decisions that will have to be observed in establishing and working of radiotelegraph stations and in handling of radiotelegrams.

In accordance with law No. 99 of 19th April, 1907, concerning wireless telegraphs (radiotelegraphs) and with the, in Berlin, the 3rd November, 1906, drawn up International Convention concerning radiotelegraphs, supplemented by appendix decisions, finishing protocol and service regulations, the following decisions will have to be observed in founding and working of radiotelegraph stations and in handling of radiotelegrams:

I.—Establishing of Radiotelegraph Stations.

1. On Danish soil and on board ships permanently anchored, such as lightships, etc., radiotelegraph stations (shore stations) can only be established by the Government.

2. On board ships under Danish flag, not owned by the Government itself, radiotelegraph stations (ship stations) may only be established and operated after permission has been obtained from the Department of Public Works.

The licence or a confirmed duplicate of it must always be carried on board the ship.

The licence may be withdrawn if the conditions for the fitting and operation of the station, set out therein, are not complied with; in such cases the entire apparatus belonging to the station must be removed.

3. Applications for licences to establish and operate radiotelegraph stations on board ships sailing under the Danish flag must be on forms

approved by the Department of Public Works, and must be accompanied by notification that the station will fulfil the following conditions:

(*a*) The system employed must be a syntonised system.

(*b*) The speed of transmission and reception must, under normal conditions, be not less than 12 words a minute, the word to consist of five letters.

(*c*) The radiotelegraph transmitter must in normal circumstances not work with a larger energy than 1 kw. Larger energy may, however, be utilised if the ship is obliged to interchange telegrams over a distance of more than 300 kw. with the nearest coast station, or if communication, due to interference, is not obtainable unless by an increase of energy.

(*d*) The station must be operated by one or more operators who have obtained certificates as specified below in section 7.

The station must not be opened for communication until the Telegraph Department has issued a certificate, which will only be granted after the Department, by inspection, is satisfied that the conditions set out in the licence granted by the Department for Public Works are fulfilled.

II.—Installation, Service and Operation of Private Ships' Stations.

4. The apparatus of ship stations must be in strict accordance with the conditions set out in the licence for their establishment.

5. The hours of service of each coast station are decided by the Government Department.

The hours of service for ship stations are decided by the ship stations themselves. Any alteration in hours of service must be reported to the Department of Telegraphs.

6. The normal wave length for ship stations is 300 m. Any ship station must be fitted to utilise this wave length, unless special permission is otherwise given. In addition to the above, wave lengths up to 600 m. may be employed.

7. The service of the ship station must be maintained by operators who are in possession of certificates granted by the Department for Public Works, which certificates specify the ability of the operator—

(*a*) In the maintenance of the apparatus;

(*b*) in the sending and receiving (by sound) of telegrams with a speed not less than 20 words a minute.

(*c*) and in knowledge of the regulations utilised, governing radiotelegraph service.

The operator is pledged to secrecy, and he is subject to the penalty, etc., for a breach of this condition as are the State telegraph operators.

In the event of a contravention of the regulations governing the operation of the radiotelegraph service, the certificate may be cancelled by the Department of Public Works.

8. The ship stations may be licensed for ordinary public telegraph communication, limited public telegraph communication (with specified ships, with specified shipping lines, with ships fitted with specified kind of apparatus, etc.), public telegraph communication over long distances, private telegraph communication, special telegraph communication (exclusively for public use, etc.).

The traffic of the ship station must be confined to that for which it is licensed, as specified in section 2; all stations are, however, bound to receive, to answer, and eventually further to communicate messages from ships in distress and give these absolute priority.

Ship stations have no responsibility whatever regarding the radio-telegraph communication.

Ship stations intended for public telegraph service must be provided with such printed forms, service journals, tariff lists, etc., as are necessary for this service; these forms are obtained from the Telegraph Department. Stations must furthermore be governed by all the instructions regarding the installation and operation of the station and the handling of the traffic issued bv the Department of Telegraphs.

No unauthorised person must be allowed to enter the wireless cabin.

9. If technically possible, ship stations must interchange telegrams with other stations (coast or ship stations), without regard to the system of radiotelegraphy employed at the corresponding station. The interchange of telegrams with other ship stations must, however, be so arranged that the working of coast stations is not interfered with, these as a rule having the priority in public telegraph service.

The operation of a station must as far as possible be arranged so that it does not disturb other stations.

Exchange of superfluous signals and words is prohibited. Trials and practice are only permitted in so far as the service of other stations is not interfered with.

When a ship is in a Danish harbour the station must only be utilised for communication with ships in distress.

10. According to the International Convention, the Telegraph Department must notify the Berne Bureau of the ship installation, and the Telegraph Department can demand to be furnished with any information regarding the installation, service and apparatus of the ship station, both for this and for other purposes.

11. The Telegraph Department will see that all conditions for fitting and operation of ship stations are complied with. The inspectors for this purpose, who are selected by the Director of Telegraphs, must at any time on showing their authority be admitted to inspect and test the station, provided that the ship is within Danish waters. All information required by the said inspectors must be immediately given, and their directions must be complied with, pending the decision of the

Director of Telegraphs, or eventually of the Department for Public Works.

For the inspection daily maintenance and travelling expenses are allowed to the inspectors; these are paid by the Department of Telegraphs, but the amount will have to be refunded (on demand) by the shipping company.

12. All pecuniary liability in respect of the service of the ship station is payable entirely by the shipping company, without regard to whether the liability in any case may have been due to fault or negligence on the part of the operators.

13. The original radiotelegrams with appendices handed in at the ship stations must if possible be sent once a month by the ship station to the Department of Telegraphs.

III.—Handling of Radiotelegrams.

14. Radiotelegraph stations open for public service for the transmission and reception of telegrams may be used by any person, unless the service at the station is limited to a certain special kind of telegrams (see section 8).

The telegrams are divided into three classes:—

(1) State telegrams.
(2) Service telegrams.
(3) Private telegrams.

The right to transmit State telegrams and service telegrams, and the right to priority for such messages, is at any time governed by the conditions laid down in the International Telegraph Regulation and the Inland Telegraph Regulation governing transmission of such telegrams over ordinary telegraph systems.

15. Regarding the radiotelegraph traffic, the handling of telegrams is governed by the International Radiotélegraph Service Regulation, Articles IX., XI., XIV., XXXIV., XXXIX., XL., XLI. The traffic of telegrams to and from coast stations and over the ordinary telegraph and telephone system is at any time governed by the Inland and International regulations for such traffic.

16. State and service telegrams may under all conditions be written in code or cypher. Private telegrams in code or cypher may be interchanged only with coast stations of such countries where this method of communication is allowed.

17. The undermentioned terms or the appended abbreviations may be utilised; they are written between two double hyphens before the address, and are charged as one word:—

To addressee only delivered	: Egenhaendigt, or MP.
Delivered open . . .	: Aabent, or RO.
Private express telegram .	: Urgent, or D.
Telegram restante . .	: TR.
X Addresses . . .	: TMX.

18. The entire charge for the handling of a radiotelegram from the sender to the addressee is to be collected from the sender by the station where it originates. The station must not collect a larger amount than allowed in the tariffs.

19. The entire charge for radiotelegrams includes—

1. Charge for the radiotelegraphic handling, namely (*a*) "coast tax," which is allotted to the coast stations; (*b*) "ship tax," which is allotted to the ship station.

2. Charge for handling over the ordinary telegraph and telephone system paid according to the general regulations.

The coast tax for Danish coast stations is 15 ctm. per word.

The ship tax is decided by the owner of the ship station, subject to the approval of the Department for Public Works. It must not exceed 40 ctm. per word; a minimum charge per telegram may, however, be adopted, not exceeding the charge for 10 words. Service telegrams concerning the radiotelegraph service are handled without any charge. Press telegrams at reduced rates are not accepted.

20. Reimbursement of charges paid, and accounts with the Telegraph Department, are governed by International Radiotelegraph Service Regulations, Articles XXXV. and XXXVI. (compare Article XLI.).

IV.—Other Regulations.

21. Stations on board ships under foreign flags must not be operated during the time such ships are in a Danish harbour, except to answer and to forward messages from ships in distress.

22. When the interests of the State requires it, the Government may reserve to itself the right to prohibit all radiotelegraphic communications from ships, Danish or foreign, in Danish waters, and to make the necessary regulations to carry out such prohibition.

23. The maximum penalty payable to the State for contravening the foregoing regulations is 400 kroner (£22), and all unlawfully fitted or utilised apparatus may be confiscated. Such contraventions are adjudicated in the public police court, and proceedings may only be taken by direction of the Minister for Public Works.

24. These regulations are effective as from the 1st of February, 1909.

SWEDEN

The Act of 1907 concerning the establishment and working of installations of radiotelegraphy and radiotelephony reads as follows:—

1. Whomsoever desires to establish in Sweden, on land, or on board a vessel permanently moored in Swedish waters, an electric installation of radiotelegraphy or radiotelephony for public or private use, must apply for an authorisation from the King.

2. The authorisation of the King must likewise be applied for, by any person or persons desiring to establish on board a Swedish vessel other than permanently moored, an installation of the kind referred to in Paragraph 1.

3. The authorisation granted by the King, as prescribed in Paragraphs 1 and 2, can only be granted for a certain time. In granting the authorisation, His Majesty prescribes, under the reservation of private rights, the manner and conditions under which the installation may be worked.

4. Whomsoever establishes or works, without the authorisation of the King or contrary to the provisions prescribed in the authorisation, an installation within the meaning of the present law, is liable to a fine of from 25 to 1,000 kronen if the penalty incurred by this contravention is not included in the Penal Code.

5. If an installation within the meaning of the present law has been established without the authorisation of the King, or contrary to the provisions prescribed simultaneously with the authorisation, or if the authorisation has been revoked later by the King, it is the duty of the Governors of Provinces to take the necessary steps to prevent any use being made of the installation.

6. Every fine imposed under the present law reverts to the State. Fines not paid on account of the insolvency of the delinquent are expurgated by terms of imprisonment as prescribed in the Penal Code.

7. The provisions of this law do not apply to State installations.

8. Regulations concerning foreign vessels not permanently moored in Swedish waters, and all dispositions which may be considered necessary for the proper working in Sweden of installations within the meaning of this Act, are made by the King.

The following Royal Decree was issued in 1907 :—

1. The working of installations of radiotelegraphy or radiotelephony on board a foreign vessel not permanently moored in Swedish waters is, except in cases of distress, forbidden in those parts of the Swedish Archipelago and Swedish waters which are within a fixed distance of any radiotelegraphic installation established by the Ministry of Marine, or in the case of public stations, by the Ministry of Posts and Telegraphs.

2. It is the duty of the authority charged with the promulgation of these provisions to communicate them to the navigators, in the way he judges most convenient, and likewise to inform the Governor of the Province involved.

3. Whomsoever desires to work a station in a Swedish port on board a foreign vessel coming within the application of the above provisions, must apply to the Ministry of Marine for an authorisation to this end, and this Ministry, after consultation with the Ministry of

Telegraphs, will decide on the matter. If the authorisation applied for is granted, it is the duty of the Ministry of Marine to give the special directions with regard to the period and conditions of installations.

4. Every contravention of this Decree, or of the regulations prescribed by the Ministry of Marine in virtue of Paragraph 2 above, will be subject to a fine of 25 to 1,000 kronen.

The fines revert to the State. Fines not payable by reason of the insolvency of the delinquent are expurgated by terms of imprisonment as laid down in the Penal Code.

5. The provisions of Paragraph 5 above do not apply to vessels of war.

SPAIN

Spain has shown a keen interest in the developments of wireless telegraphy, for in 1899 sub-commissions were appointed by the Council of State of National Defence, which issued their periodical reports to the Spanish Government; and in 1905, by Royal Decree of May 21st, a Royal and permanent Commission was created, under the presidency of the Chief of the General Staff, comprising representatives of the War, Navy and the Interior Ministries, previous to the Berlin Convention of Wireless Telegraphy of 1906.

By Royal Order of the President of Ministers and Minister of War of February 9th and 17th, 1907, respectively, the Cortes of Spain were recommended to pass a law for establishing a wireless system for communication in Spain, which law was promulgated on October 26th, 1907, followed by a Royal Decree of January 24th, 1908, declaring of national interest "the construction and erection of a net of wireless stations in the Peninsula and Canary and Balearic Islands, in order to carry out wireless communication between ships and shore stations, between the Balearic and Canary Islands and the Peninsula, Inland and International services." In the same year a public company was formed; their tender was accepted and a concession granted for the installation of a number of stations and exploitation of the wireless service, for a term of 21 years and 8 months. The contract for this important net of wireless stations was successfully carried out and is in course of completion by Marconi's Wireless Telegraph Company, Limited, for the Compania Nacional de Telegrafia sin Hilos.

In October of 1909 the Minister of Public Works called for public tenders for the carrying of mails by steamer between Spain

and its possessions in Africa, as well as to Central and South American countries, stipulating in the conditions of the tender that the ships of the firms tendering for the mail service should be provided with wireless apparatus—not only those carrying passengers, but also those carrying cargo and passengers; for the former the law to be in force from the date of accepting the tender, and the latter from January 1st, 1913.

The following Royal Decree was issued during the past year:—

1. That from the first day of August, 1912, all Spanish mercantile ships shall be fitted with wireless telegraph apparatus, provided (*a*) they are engaged in carrying passengers or mails, and (*b*) that they carry more than fifty persons on board during a transatlantic voyage, including in this number the crew.

2. The wireless telegraph apparatus shall have the necessary efficiency and be erected according to the instructions contained in the regulations issued by the Ministry of the Interior and the General Direction of Posts and Telegraphs, in order to put into force the Royal Decree of January 24th, 1908, and as a consequence of the International Congress of Berlin signed by the representatives of Spain on November 3rd, 1906.

3. This Royal Decree shall be communicated to the shipping companies, pointing out that wireless telegraph stations on board have to be approved by the Department.

4. The shipping companies shall communicate with this centre through the harbour authorities when the installation has been completed and is in a position to work efficiently, so that a technical commission may recognise and test it in order to issue a complete report of same, and to add the said report to the action with a view to finally sanctioning the service, according to previous permission of the War Office and of the Home Office.

A Bill was also submitted before the Spanish Cortes to the effect that "no passenger shall embark in Spanish ports on any ship which has not been provided with wireless apparatus, the maritime authorities only granting the necessary authorisation after ascertaining the good working order of the apparatus." This Bill did not become law, but we understand that a further attempt will be made to give effect thereto.

URUGUAY

In January, 1912, the Uruguayan Government issued a Decree compelling ships carrying passengers between the harbours of the Republic and those of foreign countries to be fitted with wireless telegraph installations:—

1. Commencing from May 1st of the present year (1912) all the ships carrying passengers between the harbours of the Republic and those of foreign countries shall be fitted with radiotelegraph installations.

2. The said installations shall be designed to receive and transmit telegrams up to a distance of not less than one hundred kilometres on the ships of river navigation, and four hundred kilometres on those of the oceanic navigation.

3. The installations shall be permanently kept in good conditions of working, and capable of intercommunicating with the stations of the Republic.

4. The stations shall be in charge of persons well acquainted with the use of radiotelegraph apparatus.

5. The service of the stations shall be entirely in accordance with the provisions of the International Radiotelegraph Convention of Berlin.

6. The agents of the companies will inform, before expiration of the time fixed, the General Inspector of the National Services of Wireless Telegraphy of the characteristics, system, power, etc., of the radiotelegraph apparatus to be fitted on the ships of their companies.

7. The ships which after expiration of the time fixed by Article 1 have not complied with the provisions of this Decree, shall not be authorised to carry passengers in the harbours of the Republic.

JAPAN

THE regulations governing the Radiotelegraphic Service of Japan provide that :—

Article 5 :—The ordinary telegraphic rates for radiotelegrams originating in Japan or transmitted to some point in the Japanese Empire, or from Manchuria, transmitted by means of a coast station and forwarded by the telegraphic network of the Empire, are as follows :

1. For radiotelegrams originating in Japan or going to a destination in Japan proper (except the Bonins Islands), exchanged by the intermediary of a coast station in Japan proper.

   For radiotelegrams originating in or going to a destination in Formosa, exchanged by the intermediary of a coast station of Formosa, or

   For radiotelegrams originating or going to destinations in Manchuria or in Korea, exchanged through the intermediary of a coast station in Manchuria :

   25 sen for 5 words.

   5 sen for every word over 5 words.

2. For radiotelegrams originating in or going to a destination in the Islands of Bonins, in Korea, in Formosa, in Japanese Sakhalin, or in Manchuria, and exchanged through the intermediary of a coast station of Japan proper ;

For radiotelegrams originating in or going to a destination in Japan proper, in the Islands of Bonins, in Korea, in Japanese Sakhalin or in Manchuria, and exchanged through the intermediary of a coast station of Formosa; or

For radiotelegrams originating in or going to a destination in Japan proper, the Islands of Bonins, Formosa, or in Japanese Sakhalin, and exchanged through the intermediary of a coast station of Manchuria:

State radiotelegrams, 25 sen for 5 words, 5 sen per word for every word over 5 words.

Private radiotelegrams, 40 sen for every 5 words, 5 sen for every word over 5.

CHINA

Colony of Hongkong

THERE are no wireless telegraph stations in operation in the Colony of Hongkong (February, 1913), but the Crown Agents for the Colonies are about to call for tenders for a 5 k.w. station, to be erected by the Government in Hongkong.

It will be noticed from the following ordinances and regulations that the control of wireless telegraphy in the Colony of Hongkong is entirely in the hands of the Local Government. The first ordinance, which was passed in 1903, reads:—

NO. 7 OF 1903.

An Ordinance to authorize and regulate the establishment and use of installations for the purpose of Wireless Telegraphy.

BE it enacted by the Governor of Hongkong, with the advice and consent of the Legislative Council thereof, as follows:—

1. This Ordinance may be cited for all purposes as The Wireless Telegraphy Ordinance, 1903.

2. The Governor may, whenever he shall deem it expedient to do so, licence the establishment and use within the Colony of installations for the purpose of wireless telegraphy.

3. No person shall establish or use within the Colony any installation for the purpose of wireless telegraphy unless authorised to do so by a licence under this Ordinance.

4. A licence under this Ordinance may be issued subject to such conditions and stipulations as the Governor may from time to time find desirable in the public interest.

Passed the Legislative Council of Hongkong, this 8th day of July, 1903.

In 1909 the following was passed:—

NO. 4 OF 1909.

An Ordinance to amend The Wireless Telegraphy Ordinance, 1903.

BE it enacted by the Governor of Hongkong, with the advice and consent of the Legislative Council thereof, as follows:—

1. This Ordinance may be cited as The Wireless Telegraphy Ordinance 1909 and shall be read and construed as one with the Wireless Telegraphy Ordinance 1903.

2. The Governor may from time to time make Regulations as to the use of wireless telegraph apparatus on merchant ships whether British of Foreign while in the territorial waters of the Colony and may by such Regulations impose penalties for the breach thereof.

Passed the Legislative Council of Hongkong, this 13th day of May, 1909.

NO. 42 OF 1909.

An Ordinance to amend the Wireless Telegraphy Ordinance, 1903, and the Wireless Telegraphy Ordinance, 1909.

BE it enacted by the Governor of Hongkong, with the advice and consent of the Legislative Council thereof, as follows:—

1. This Ordinance may be cited as "The Wireless Telegraphy Amendment Ordinance, 1909," and shall be read and construed as one with the Wireless Telegraphy Ordinance, 1903, and the Wireless Telegraphy Ordinance, 1909, and this Ordinance and the said Ordinances may be cited together as "The Wireless Telegraphy Ordinances, 1903-1909."

2. The following shall be inserted and read as section 5 of the Wireless Telegraphy Ordinance, 1903:—

> "5. If any person establishes or uses within the Colony any installation for the purpose of wireless telegraphy without a licence under this Ordinance he shall be guilty of a misdemeanour and shall be liable to imprisonment with or without hard labour for any term not exceeding one year or to a fine not exceeding one thousand dollars or both and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this section except by order of the Governor."

Hon. R. Heaton Rhodes
(Postmaster-General, New Zealand).

[*To face page* 156

3. Section 2 of the Wireless Telegraphy Ordinance, 1909, is hereby amended by the addition at the end thereof of the following words:—

> "not exceeding one hundred dollars for each offence and may provide for the forfeiture on any such breach of any apparatus for wireless telegraphy installed or worked on such ships."

Passed the Legislative Council of Hongkong, this 9th day of December, 1909.

In pursuance with the powers granted under Section 2 of Ordinance No. 4. of 1909, the following regulations with regard to the use of wireless telegraph apparatus on merchant ships were made by the Governor on the 23rd of April, 1910, and published on the 30th of April, 1910.

1. All apparatus for wireless telegraphy on board a merchant ship in the territorial waters of the Colony shall be worked in such a way as not to interfere with (*a*) Naval signalling or (*b*) the working of any wireless telegraph station lawfully established, installed, or worked in the Colony or the territorial waters thereof, and in particular the said apparatus shall be so worked as not to interrupt or interfere with the transmission of any messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea.

2. No apparatus for wireless telegraphy on board a merchant ship shall be worked or used whilst such ship is in any of the harbours of the Colony except with the special or general permission in writing of the Postmaster-General of the Colony.

3. If at any time in the opinion of the Governor an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy the use of wireless telegraphy on board merchant ships whilst in the territorial waters shall be subject to such further rules as may be made by the Governor from time to time, and such rules may prohibit or regulate such use in all cases or in such cases as may be deemed desirable.

4. These regulations shall not apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

5. Every person who commits a breach of any of the above Regulations shall be guilty of a misdemeanour and shall be liable on summary conviction before a magistrate to a fine not exceeding one hundred dollars and shall also be liable to forfeit any apparatus for wireless telegraphy worked or used in contravention of the said Regulations.

6. No proceedings shall be taken against anv person under these Regulations except by order of the Governor.

The following Regulations were made under Section 2 of the Wireless Telegraphy Ordinance, 1909 (Ordinance No. 4 of 1909), on the 29th of April, 1912.

The Regulations made by the Governor with regard to the use of wireless telegraph apparatus on merchant ships and published on the 30th of April, 1910, are hereby amended as follows:—

Regulation 2 is hereby revoked and the following is substituted therefor:—

"2. No apparatus for wireless telegraphy on board a merchant ship shall be worked or used whilst such ship is in any of the harbours of the Colony except with the special or general permission in writing of the Colonial Secretary of the Colony."

Weihaiwei

No. 1 of 1904.

1. It shall not be lawful for any person to use or establish any apparatus or installation for the purpose of operating a wireless electric telegraph without a licence from the Commissioner on such terms and conditions as the Commissioner may from time to time prescribe.

2. Any person who commits any offence against the provisions of this Ordinance shall be liable to a fine not exceeding $500 or in default of payment thereof to imprisonment for a term not exceeding six months, with or without hard labour.

Shanghai

We understand that the Board of Communications at Peking is at present considering laws and regulations concerning wireless telegraphy. The existing wireless telegraph station at Shanghai is governed by the regulations of the International Convention.

BAHAMAS

An Act to restrict the use of wireless telegraphy except under certain conditions (1902):—

1. This Act may be cited for all purposes as "The Wireless Telegraphy Restriction Act, 1902."

2. From and after the passing of this Act it shall be unlawful for any person in these islands to transmit or receive messages across the seas by means of any wireless telegraphy whatsoever ("*or to erect, construct, establish, or maintain any instrument or apparatus for the purpose of transmitting or receiving such messages*"—added by an Act of 1903), unless such person shall have previously received the consent in writing, under the hand of the Colonial Secretary of the Governor in Council, authorising the same.

3. Any person violating the provisions of this Act shall be liable, on summary conviction, to a penalty not exceeding £200, anything in the Magistrates' Act, 1896, to the contrary notwithstanding.

BARBADOS

Wireless Act, 1905.

1. This Act may be cited as the Wireless and Submarine Telegraph Act, 1905.

2. (1) The West India and Panama Telegraph Company shall not lay down or maintain a new telegraph cable nor shall any other company or person lay down or maintain any telegraph cable upon the foreshore and bed of the sea except under and in accordance with an Act of the Legislature.

(2) A person shall not establish any wireless telegraph station, or instal or work any apparatus for wireless telegraphy in any place in this island except under and in accordance with an Act of the Legislature.

(3) If the West India and Panama Telegraph Company lays down or maintains a new telegraph cable or if any other company or person lays down or maintains any telegraph cable upon the foreshore or bed of the sea without the authority of an Act of the Legislature in that behalf, the company or person shall be liable, on conviction before a Police Magistrate, to a penalty not exceeding £100 and shall forthwith remove the telegraph cable, and if the telegraph cable be not removed within one day after such conviction the company or person shall be liable to a penalty not exceeding £50 for each day thereafter during which the company or person shall fail to remove the telegraph cable. Provided, that the Governor-in-Executive Committee may at any time after the expiration of one day from the date of the conviction cause the same to be removed and destroyed.

(4) If any person establishes a wireless telegraph station without the authority of an Act of the Legislature in that behalf, or instals

or works any apparatus on any place in this island for wireless telegraphy without such authority in that behalf he shall be liable, on conviction before a Police Magistrate, to a penalty not exceeding £100, and further be liable to forfeit any apparatus for wireless telegraphy installed or worked without such authority.

(5) If a Police Magistrate is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without legal authority in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place within his jurisdiction without such authority in that behalf, he may grant a search warrant to any police officer named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station or place and to seize any apparatus which appears to him to have been used, or intended to be used, for wireless telegraphy therein.

(6) No proceedings shall be taken under any of the provisions of this section except by order of the Governor.

3. This Act shall continue in force until the 31st day of March, 1907. (*By an amending Act of* 1908, *this Act continues in force until repealed by the Legislature.*)

BERMUDA

THE WIRELESS TELEGRAPH ACT, 1903.

1. From and after the passing of this Act it shall not be lawful for any person in these islands to transmit or receive messages across the seas (*by an Act of* 1910 *this was amended by the addition of the words " or between places in these islands "*) by means of any wireless telegraphy, or to instal, erect, construct, establish, or maintain in these islands any instrument, apparatus, or other thing for the purpose of transmitting or receiving such messages, unless such person shall hold a written licence from the Governor authorising the same, and such licence shall be in force and unrevoked; and any person who shall offend against the provisions of this enactment shall be liable, on summary conviction before any two justices, for a first offence to a penalty not exceeding £25, and for a second or subsequent offence to a penalty not exceeding £100.

2. Any licence issued by the Governor under this Act may at any time be revoked by him by a written notice given to the person to whom such licence was issued, or by the publication of such revocation in the *Gazette*, and after such revocation such person shall not be entitled to any privilege or protection by virtue of such licence.

3. Any licence under this Act may be issued subject to such conditions and restrictions as the Governor may from time to time consider desirable in the public interest.

4. If any Justice of the Peace shall be satisfied from the information on oath of any credible person that there is good reason to believe that any of the provisions of the first section of this Act have been or are being violated, he may issue a search warrant to any constable or constables authorising and requiring him or them, with or without assistants, at any hour of the day or night, to enter into, and go through and search, inspect and examine any premises where such violation is suspected to have been or to be committed for the purpose of ascertaining whether such violation has been or is being committed; and if, upon such search, any instrument, apparatus, or other thing apparently used, or capable of being used, for the purpose of transmitting or receiving messages across the sea by wireless telegraphy shall be found, it shall be lawful for such constable or constables to seize and carry away, or otherwise to secure the same; and if, upon a hearing before any two Justices of the Peace, they shall adjudge and determine that any such instrument, apparatus, or other thing, has been used, or is capable of being used, for either of the purposes aforesaid, they may adjudge the same to be forfeited, and such forfeiture may be in addition to any penalty which may be imposed on any person under this Act in respect of such instrument, apparatus, or other thing.

5. Any instrument, apparatus, or other thing which shall be adjudged to be forfeited under the provisions of this Act shall be sold or otherwise disposed of in such manner as the Governor shall direct, and if sold the net proceeds of such sale shall be paid into the public treasury, after payment thereout of such reward, if any, as the Governor shall award to the informer, or to any constable or constables executing the search warrant under which such articles were seized.

6. This Act shall continue in force until and throughout the last day of December, 1907. (*By the Wireless Telegraphy Act Continuing Act,* 1907, *the Act of* 1903 *is continued in force indefinitely.*)

1909.

The Governor having informed the Legislature that a despatch has been received from the Secretary of State for the Colonies drawing attention to the desirability of making Regulations as to the use of Wireless Telegraphy apparatus on merchant ships, whether British or foreign, while in the territorial waters in these islands, and it was deemed expedient to confer on the Governor in Council the power to make such Regulations as may be necessary for the purpose aforesaid, and the following Act came into force in March, 1909:—

1. It shall be lawful for the Governor in Council to make regulations as to the use of wireless telegraph apparatus on merchant ships, whether British or foreign, while in the territorial waters of

these islands, for preventing such apparatus being worked so as to interfere with naval signalling, or with the working of any wireless telegraph station lawfully established or worked in these islands, or with the transmission of messages between any such station and ships at sea.

2. If at any time, in the opinion of the Governor, an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy, the use of wireless telegraphy on board merchant ships whilst in the territorial waters of these islands shall be subject to such further regulations as may be made by the Governor from time to time, and such regulations may prohibit or regulate such use in all cases, or in such cases as may be deemed desirable.

3. Any regulations made under this Act may impose fines for any breach thereof not exceeding £20 for a single offence, and not exceeding £5 a day for a continuing offence, and such fines shall be recoverable with costs in any Court of Summary Jurisdiction consisting of any two Justices of the Peace.

4. All regulations made under this Act shall become operative on the date of their publication in the *Gazette,* or on such later date as shall be fixed by the regulations for the purpose.

BRITISH GUIANA

1. This Ordinance may be cited as "The Telegraph Ordinance, 1903."

2. In this Ordinance "Telegraph" means an electric, galvanic, or magnetic telegraph, and includes appliances and apparatus for transmitting or making telegraphic, telephonic or other communication by means of electricity, galvanism or magnetism, whether the same be transmitted by means of wires or cables or without wires or cables.

3. The Governor-in-Council shall have the exclusive privilege of establishing, maintaining and working telegraphs between the Colony and places outside of the Colony.

Provided that the Governor-in-Council may grant a licence on such conditions and in consideration of such payments as he thinks fit, to any person, company or body corporate, to establish, maintain, or work a telegraph between the Colony and any place or places outside the Colony; and

Provided that nothing in this Ordinance shall apply to or in any way affect the rights already granted to the West India and

Panama Telegraph Company, Limited, under any Ordinance or Ordinances passed before the commencement of this Ordinance.

ORDINANCE NO. 7 OF 1910.

1. (1) A person shall not establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy in any place or on board any British ship registered in the Colony, except under and in accordance with a licence granted in that behalf by the Governor-in-Council.

(2) A person shall not work any apparatus for wireless telegraphy installed on any merchant ship (whether British or foreign) whilst that ship is in the territorial waters of the Colony, otherwise than in accordance with regulations made in that behalf by the Governor-in-Council, and the Governor-in-Council may, by any such regulations, impose penalties recoverable summarily for the breach of any such regulations, not exceeding fifty dollars for each offence, and may provide for the forfeiture on any such breach of any apparatus for wireless telegraphy installed or worked on such ship.

(3) If any person establishes a wireless telegraph station without a licence in that behalf, or instals or works any apparatus for wireless telegraphy without a licence in that behalf, he shall be guilty of a misdemeanour and be liable on summary conviction thereof to a penalty not exceeding fifty dollars, and, on conviction on indictment, to a fine not exceeding five hundred dollars, or to imprisonment, with or without hard labour, for a term not exceeding twelve months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence.

(4) If a Justice of the Peace is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any merchant ship within his jurisdiction without a licence in that behalf or contrary to the provisions of the regulations made under sub-section two of this section he may grant a search warrant to any police officer or any officer appointed in that behalf by the Governor or the Postmaster-General and named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station, place or ship and to seize any apparatus which appears to him to be used or intended to be used for wireless telegraphy therein.

(5) The expression " wireless telegraphy " means any system of communication by telegraph without the aid of any wire connecting the points from and at which the messages or other communications are sent and received: *Provided,* That nothing in this Ordinance shall prevent any person from making or using electrical apparatus for

actuating machinery or for any purpose other than the transmission of messages.

2. This Ordinance may be cited as the Wireless Telegraphy Ordinance, 1910.

BRITISH HONDURAS

Ordinance No. 13.—1903.

1. It shall not be lawful for any person to use or establish any apparatus or installation for the purpose of operating a wireless electric telegraph without a licence from the Governor on such terms and conditions as the Governor may from time to time prescribe.

2. Any person who commits any offence against the provisions of this Ordinance is guilty of a misdemeanour within the meaning of the Criminal Code.

EAST AFRICA PROTECTORATE

An Ordinance to provide for the regulation of Wireless Telegraphy was issued on 2nd November, 1908:—

1. (1) A person shall not establish any wireless telegraph station or instal any apparatus for wireless telegraphy in any place except under and in accordance with a licence granted in that behalf by the Governor.

(2) Every such licence shall be in such form and for such period as the Governor may determine, and shall contain the terms, conditions and restrictions on and subject to which the licence is granted, and any such licence may include two or more stations or places.

(3) If any person establishes a wireless telegraph station without a licence in that behalf or instals or works any apparatus for wireless telegraphy without a licence in that behalf he shall be guilty of an offence under this Ordinance, and on conviction he shall be liable to a fine not exceeding one thousand and five hundred rupees or to simple imprisonment for a term not exceeding twelve months or to both, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this Ordinance except by the order of the Governor.

(4) If a Magistrate is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence in that behalf or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship within his jurisdiction without a licence in that behalf, he may grant a warrant to any police officer or any other officer appointed in that behalf by the Governor and named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station or place or

ship and to seize any apparatus which appears to him to be used or intended to be used for wireless telegraphy therein.

(5) The Governor may make regulations for prescribing the form and manner in which applications for licences under this Ordinance are to be made and fees payable on the grant of any such licence.

(6) The expression "Wireless Telegraphy" means any system of communication by telegraph as defined in the Indian Telegraph Act, 1883, without the aid of any wire connecting the points from and at which the messages or other communications are sent and received. Provided that nothing in this Ordinance shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

Where the applicant for a licence proves to the satisfaction of the Governor that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions and restrictions as the Governor may think proper, but shall not be subject to any rent or royalty.

2. A person shall not work any apparatus for wireless telegraphy installed on any ship whilst that ship is in the Protectorate waters, otherwise than in accordance with regulations made in that behalf by the Governor, and the Governor may by any such regulations impose penalties for the breach of any such regulations not exceeding one hundred and fifty rupees for each offence and may provide for the forfeiture on any such breach of any apparatus for wireless telegraphy installed or worked on such ship. Save as aforesaid nothing in this Ordinance shall apply to the working of apparatus for wireless telegraphy installed on any foreign ship.

3. The term "ship" includes steamers, sailing ships, dhows, lighters, rafts and every other form of boat.

The term "Magistrate" means a Magistrate holding a Subordinate Court of the first or second class.

4. This Ordinance may be cited as the "Wireless Telegraphy Ordinance 1908."

FALKLAND ISLANDS

THE following Ordinance relating to wireless telegraphy came into force on March 15, 1912:—

1. No person shall establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy in any place or on board any British ship registered in the Colony except under and in accordance with a licence granted in that behalf by the Governor in Council.

2. No person shall work any apparatus for wireless telegraphy installed on any merchant ship (whether British or foreign) whilst that ship is in the territorial waters of the Colony, otherwise than in

accordance with regulations made in that behalf by the Governor in Council, and the Governor in Council may, by any such regulations, impose penalties, recoverable before a Stipendiary magistrate or any two Justices of the Peace in a summary manner, for the breach of any such regulations, not exceeding twenty pounds for each offence, and may provide for the forfeiture on any such breach of any apparatus for wireless telegraphy installed or worked on such ship.

3. If any person establishes a wireless telegraph station without a licence in that behalf or installs or works any apparatus for wireless telegraphy without a licence in that behalf he shall be guilty of a misdemeanour and be liable on summary conviction thereof to a penalty not exceeding twenty pounds or to imprisonment not exceeding three months, and, on conviction in the Supreme Court, to a fine not exceeding one hundred pounds, or to imprisonment for a term not exceeding twelve months and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence.

4. If a Justice of the Peace is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence in that behalf, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any merchant ship within his jurisdiction without a licence in that behalf or contrary to the provisions of the regulations made under this Ordinance, he may grant a search warrant to any constable or to any officer appointed in that behalf by the Governor and named in the warrant, and a warrant so granted shall authorise the officer named therein to enter and inspect the station, place or ship and to seize any apparatus which appears to him to be used or intended to be used for wireless telegraphy therein.

5. The expression "wireless telegraphy" means any communication by telegraph without the aid of any wire connecting the points from and at which the messages or other communications are sent and received: Provided that nothing in this Ordinance shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

6. The Wireless Telegraphy Ordinance, 1903, is hereby repealed.

7. This Ordinance may be cited as the Wireless Telegraphy Ordinance, 1912.

GAMBIA

12th February, 1903.

An Ordinance to secure the control of all telegraphic establishments within the Colony and Protectorate in so far as may be necessary for the public safety:—

1. No company, corporation, persons, or person whatsoever shall within the limits to which this Ordinance applies establish, maintain or use any telegraphic apparatus, mechanism or contrivance, of what

nature or kind soever the same may be, without due permission and licence under the hand of the Governor previously obtained for that purpose.

It is hereby expressly declared that what is commonly known as "wireless telegraphy," including the Marconi apparatus and any similar or other mechanism or contrivance whatsoever for the transmission of telegraphic messages without the employment of wires or cables, is a telegraphic apparatus, mechanism, or contrivance within the meaning of this section.

2. It shall be lawful for the Governor-in-Council from time to time to make, and as he shall see fit repeal, alter or vary rules and regulations for all or any of the following purposes, viz.:—

Licensing companies, corporations, or individuals to establish, maintain, or use any telegraphic apparatus, mechanism or contrivance, whether for the service of the public or for any private purpose.

Attaching conditions, restrictions, and limitations to the exercise of the privilege by such licence conferred.

Attaching suitable penalties and forfeitures to the contravention of the prohibition above contained in section 1 of this Ordinance, and to the breach of any rule or regulation made thereunder, and providing for the recovery thereof, summarily or otherwise. Provided that the penalty (over and above forfeiture) to be imposed for any one offence shall in no case exceed a fine of £200, or in default of payment thereof imprisonment with or without hard labour for a period not exceeding twelve months.

The exercise of all such powers and control over telegraphic establishments (by temporarily entering into possession thereof or otherwise) as may be necessary for the public safety, whether at all times or in any case of emergency which may arise.

And generally for the better carrying out of the purposes of this Ordinance.

Such rules and regulations shall come into force as from the date of publication thereof, subject to disallowance by His Majesty.

3. Nothing in this Ordinance contained shall invalidate or impair any agreement now in force entered into between the Governor of this Colony, or the Imperial Government on behalf of the Government of this Colony, and any telegraph company, relative to the laying down or landing of any telegraphic cable, the removal, renewal, maintenance and use thereof, or to the payment of any subsidy to such company by the Government of this Colony or any other the like matter.

4. This Ordinance may be cited for all purposes as "The Telegraphic Establishments (Maintenance of Control) Ordinance, 1903," and shall apply to the whole Colony and Protectorate and to the territorial waters thereof.

GOLD COAST COLONY

An Ordinance to regulate communication by Wireless Telegraphy was issued on 22nd September, 1903:—

1. This Ordinance may be cited as "The Wireless Telegraphy Ordinance, 1903."

2. No person shall establish or use any apparatus or installation for the purpose of communication by wireless telegraphy without a licence from the Governor. Any such licence may be granted on such terms and conditions as the Governor may prescribe.

3. Any person who shall contravene the provisions of the preceding section or any of the terms or conditions of any licence granted hereunder shall be guilty of an offence and shall on conviction before a District Commissioner be liable to a penalty not exceeding £100 or to imprisonment with or without hard labour for a period not exceeding six months or to both, and the apparatus or installation in respect of which the offence is committed shall be forfeited to His Majesty.

4. The Governor in Council may from time to time make, revoke or alter rules for further or better carrying into effect any of the purposes of this Ordinance, and such rules shall on publication in the "Gazette" have the same effect as if enacted in this Ordinance.

GRENADA

The Wireless Telegraph Ordinance, 1903.

1. In this Ordinance the term "Wireless Telegraphy" means any system or installation, designed or constructed for the transmission or receipt of any messages or communications to or from a distant place by means of electric currents and signals generated by any apparatus or instrument which system, installation or instrument is unconnected by wire or other tangible attachment with such distant place. The term "Wireless Telegram" means any message or communication transmitted, or intended for transmission, by Wireless Telegraphy.

2. The Governor in Council and the servants of the Government of the Colony shall have the exclusive privilege of installing, erecting, maintaining, and using in this Colony apparatus intended for Wireless Telegraphy, and also the incidental services of transmitting, receiving, collecting or delivering Wireless Telegrams.

3. It shall not be lawful for any person to instal, erect, maintain or use in this Colony any apparatus or instrument for the purpose of Wireless Telegraphy without having previously obtained from the Governor a licence in that behalf to be granted on such terms and conditions as the Governor may prescribe.

4. Any person contravening the provisions of this Ordinance shall be liable on conviction to a fine not exceeding Fifty Pounds, and the apparatus and installation in respect of which a conviction is obtained may by order of the Magistrate before whom such conviction is obtained be forfeited to the use of His Majesty the King.

5. All proceedings under this Ordinance may be taken before the Magistrate of the Southern District or any other person appointed by the Governor for the purpose of hearing and deciding the case; and the mode of procedure shall be according to the law in force for the time being in respect of other offences punishable on summary conviction.

6. This Ordinance may be cited as "The Wireless Telegraph Ordinance."

JAMAICA

The Telegraph Control Law, 1904.

1. No person shall, within the Colony or any of its Dependencies, establish, maintain or use any telegraphic apparatus, mechanism, or contrivance, of what nature or kind soever the same may be, without due permission or licence under the hand of the Governor previously obtained for that purpose.

It is hereby expressly declared that what is commonly known as "wireless telegraphy," including the Marconi apparatus and any similar or other mechanism or contrivance whatsoever for the transmission of telegraphic messages without the employment of wires or cables, is a telegraphic apparatus, mechanism, or contrivance within the meaning of this Section.

2. It shall be lawful for the Governor in Privy Council from time to time to make and as he shall see fit repeal, alter or vary rules and regulations for all or any of the following purposes, viz:—

Permitting or licensing any person to establish, maintain, or use any telegraphic apparatus, mechanism, or contrivance, whether for the service of the public or for any private purpose;

Attaching conditions, restrictions, and limitations to the exercise of the privilege by such permission or licence conferred:

Providing suitable penalties and forfeitures for the contravention of the prohibition above contained in Section 1 of this law, and to the breach of any rule or regulation made thereunder, and providing for the recovery thereof, summarily or otherwise; provided that the penalty (over and above forfeitures) to be imposed for any one offence shall in no case exceed a fine of Two Hundred Pounds, or in default of payment thereof imprisonment, with or without hard labour, for a period not exceeding twelve months;

The exercise of all such powers and control over telegraphic establishments (by temporarily entering into possession thereof or

otherwise) as may be necessary for the public safety, whether at all times, or in any case of emergency which may arise;

And generally for the better carrying out of the purposes of this law.

Such rules and regulations shall come into force as from the date of publication thereof in the *Jamaica Gazette.*

3. Nothing in this law contained shall invalidate or impair any legal right already possessed by any telegraph or cable company, relative to the laying down or landing of any telegraphic cable, the removal, renewal, maintenance, and use thereof, or any other like matter.

4. Law 1 of 1903 is hereby repealed.

Law 21 of 1909.

The Direct West India Cable Company's Law, 1909.

Whereas the Direct West India Cable Company, Limited, is desirous of establishing a wireless installation for communication between ships and the shore in Jamaica;

And whereas under the provisions of Law 7 of 1904, entitled "The Telegraph Control Law, 1904," no person shall establish, maintain, or use within the Island of Jamaica, or any of its Dependencies, any apparatus or machine whereby communication by Wireless Telegraphy can be held between the said Island and ships, without having first obtained the sanction of and a Licence from the Governor;

And whereas a Licence to erect such a wireless station has been granted to the Direct West India Cable Company, Limited, by the Governor of Jamaica;

Be it enacted by the Governor and Legislative Council of Jamaica, as follows :—

1. The protection, rights, powers, and facilities already granted to The Direct West India Cable Company, Limited, under Law 16 of 1898, entitled "The Direct West India Cable Companv's Law, 1898," are granted and extended for the purposes of wireless telegraphy installation to be installed by the company or worked and maintained by them in so far as they may be applicable to the satisfactorv and efficient working and maintenance of a wireless station or stations.

2. The Government of Jamaica shall acquire for the use and at the expense of the company a piece of land of sufficient dimensions at a place to be selected by the company and approved by the Government suitable and convenient for the economical erection, maintenance, and working of the installation, and when acquired such piece of land shall be conveyed to the company in fee simple, or if the Government of Jamaica possesses a piece of land of sufficient dimensions at a place approved by the company suitable and convenient for the economical erection, maintenance, and working of the installation and which the

Government considers it desirable the company should have, the Government may sell the said piece of land at a price to be mutually agreed upon, or the Government may rent it to the company on such terms as may be agreed on during the period of the licence or for so long as the company may continue to work a wireless station or stations.

The acquisition of land by the Government of Jamaica under this section shall be deemed as an acquisition for public work within the meaning of the Public Lands Acquisition Law, 1897 (Law 31 of 1897).

MAURITIUS

An Ordinance (No. 33) was issued in 1903 empowering the Governor to grant or withhold leave to erect receiving and transmitting stations for Wireless Telegraphy.

Clause 1 reads :—

> No telegraphic or electrical station, apparatus, machinery, or implements whatsoever, for the purpose of electrical communications, transmission, emission, or reception of messages, by what is generally known as "wireless telegraphy," between any places in Mauritius, or between any place in Mauritius with any place out of Mauritius, shall be erected or used in any place in Mauritius, whether on public or private property, without the sanction of the Governor previously obtained.

Section 2 reads :—

> The Governor may refuse such sanction or grant it under such conditions as he may think fit.

By Section 3 :—

> The word "place" in paragraph (1) shall include any ship or floating conveyance within or without the waters of Mauritius, except vessels of His Majesty's Navy.

Clause 2 :—

> Any person contravening any of the provisions of this Ordinance shall be liable to a fine not exceeding 5,000 rupees, and every apparatus, machinery, or implement used in, or connected with, the commission of the offence shall be forfeited.

Clause 3 :—

> The Court may further order, on the application of the Ministère Public, or person authorised by the Ministère Public, the immediate pulling down or removal of any building, apparatus, machinery, or implement used in the commission of the offence.

The Wireless Telegraphy Ordinance No. 33 of 1903 has been

amended by the Wireless Telegraphy (Amendment) Ordinance, 1912, the effective clause (1) of which reads :—

> It shall be lawful for the Governor in Executive Council to make regulations concerning the use of wireless telegraphy on board merchant ships, whether British or foreign, while in the territorial waters of this Colony.

NORTH NIGERIA

The following Proclamation providing for the control by the Governor of electrical communication by Wireless Telegraphy was issued in 1904 :—

1. This Proclamation may be cited as the Wireless Telegraphy Proclamation.

2. No person shall import, keep, use or establish any apparatus or installation for transmission of messages by wireless telegraphy without previously obtaining from the Governor a licence setting forth the terms and conditions upon which the same is granted.

3. Any person infringing this Proclamation shall be liable upon conviction in addition to confiscation of every such apparatus and installation to a penalty not exceeding £500 or in default to imprisonment for a term not exceeding twelve months or to both.

4. It shall be lawful for the Governor from time to time by Proclamation to prescribe the terms and conditions upon which, if at all, such licence is granted.

NORWAY

The Norwegian State Telegraph Department issued in December, 1908, the following "Notice to Mariners" applying to wireless telegraph equipments on board ships in Norwegian territorial waters :—

1. Wireless telegraph or wireless telephone stations on board foreign vessels must not be employed, except by special permission, within Norwegian territorial waters. Requests for such permission must be sent to the Telegraph Department, which will communicate its decision after conference with the Marine Department.

2. Permission to use the stations on board foreign vessels, when within Norwegian territorial boundaries, may be restricted to certain fixed places, or to certain fixed periods of the 24 hours. Correspondence by means of the wireless apparatus shall be at once suspended whenever it shall be so desired by the Telegraph Department, the Marine Department, or by any one of the coast stations under their authority.

3. During the stay of a vessel in a Norwegian harbour, within a distance of 5 kilometres ($2\frac{7}{10}$ths miles) from the nearest telegraph station,

Hon. H. J. B. Woods
(Postmaster-General, Newfoundland).

[To face page 172

the station on board a foreign vessel must not be employed for telegraphing either with Norwegian or foreign coast stations. Without special permission, the station during a vessel's stay in a Norwegian harbour must not be employed for communicating with other ship station, except for the purpose of preventing accidents.

4. The regulations above mentioned do not, however, apply to stations on board vessels of war belonging to foreign powers, which carry on mutual correspondence. Such stations are, however, bound to submit themselves to the regulations contained in the second clause of Section 2.

5. Whenever the station on board a foreign vessel is employed during her stay in Norwegian territorial waters, this shall be done subject to the regulations contained in the International Telegraph Convention, with the rules pertaining thereto.

The law of July 16th, 1907, reads as follows:—

1. Stations or establishments of wireless telegraphy or telephony can be installed and worked within, as well as without, the limits of the kingdom, on vessels carrying the Norwegian flag and not belonging to the Norwegian Navy, after a grant of a licence from the King or a person authorised by him, on certain definite conditions and for a prearranged period of time. This licence can be annulled at any time if the provisions therein established are not observed.

Transmission by wireless telegraphy or telephony on vessels sailing under foreign flags in Norwegian territorial waters—even when the vessels have received a concession from the authorities of the foreign country—can only be carried out on condition of conforming to the regulations made by the King, or by the person authorised by him, who, moreover, is empowered to forbid, if necessary and circumstances demand it, all telegraphic or telephonic transmission.

2. The exceptions mentioned in the law of April 29th, 1899, under Article 1, Paragraph 2, relative to the working of establishments for common or private use, or concerning establishments created by railway companies for their own use, are not applicable to the working of establishments of wireless telegraphy or telephony.

3. Every contravention of the present law will be subject to the penalties prescribed in Article 6 of the law of April 9th, 1899.

The following regulations are based on the law of July 10th, 1907, and were approved by the Royal Decree of October 24th, 1908:—

1. No radiotelegraphic station on board a foreign vessel within the limits of Norwegian territorial waters can be used without a special licence.

Application for such licence must be made to the Ministry of Telegraphs, which Ministry, after consultation with the Ministry of Marine, will decide on the application.

2. The licence granting the right to use wireless telegraphic stations within the radius of Norwegian territorial waters may be limited to definite places and to fixed hours of the day.

Wireless transmission of messages must be stopped immediately on the order of the Ministry of Telegraphs, Ministry of Marine, or of any coast station established by the aforesaid Ministries.

3. If the vessel is in a Norwegian port situated within a radius of 5 kilometres from the nearest telegraphic station, the station on board the vessel cannot communicate either with Norwegian coast stations or with foreign coast stations.

Without a special licence, a wireless station on board a vessel in a Norwegian port cannot be used for the exchange of messages with other ship stations, unless for the purpose of advising accidents.

4. However, the preceding provisions do not apply to foreign ships of war, as far as the interchange of messages between themselves is concerned.

It is the duty, nevertheless, of stations on board foreign warships to conform to the provisions in Article 2, Paragraph 2, above.

5. If a station is used when a ship is in Norwegian territorial waters this station must conform to the provisions of the International Telegraphic Convention, and the regulations appended thereto.

NYASALAND PROTECTORATE

1. This Ordinance may be cited as "The Wireless Telegraphy Ordinance, 1908."

2. No person shall establish or use any apparatus or installation for the purpose of operating wireless telegraphs without a licence from the Governor.

Any person contravening this section shall be liable on conviction to a fine not exceeding £100 or to imprisonment with or without hard labour for a term not exceeding twelve months with or without the option of a fine, and in addition any apparatus or installations in respect of which an offence under this section is committed may be forfeited and sold or disposed of as the Governor may direct.

3. The Governor in Council may from time to time make, and when made shall publish in the *Gazette*, rules prescribing the terms and conditions upon which licences to establish or use apparatus or installations for the purpose of operating wireless telegraphs may be granted, and may impose a penalty on conviction for breach of any rules so made of a fine not exceeding £50 or imprisonment

with or without hard labour for a term not exceeding six months with or without the option of a fine, and such Rules may further provide for forfeiture and sale or disposal as the Governor may direct of any such apparatus or installations as aforesaid.

SAINT HELENA

THE following Ordinance provides for the regulation of wireless telegraphy :—

1. From and after the passing of this Ordinance the Governor-in-Council may make regulations as he may deem requisite for regulating the use of wireless telegraphy on merchant ships whether British or foreign while in the territorial waters of this Colony.

2. The Master of any ship and any person who shall act in contravention of any regulation now published or which may hereafter be published shall be liable on conviction to a penalty not exceeding ten pounds.

3. This Ordinance may be cited as "The Wireless Telegraphy Ordinance, 1912."

REGULATIONS.

Made by the Governor-in-Council under Ordinance No. 7 of 1912, entitled "An Ordinance to provide for the Regulation of Wireless Telegraphy."

(1) All apparatus for wireless telegraphy on board a merchant ship in the territorial waters of this Colony shall be worked in such a way as not to interfere with (*a*) naval signalling or (*b*) the working of any wireless telegraph station lawfully established, installed, or worked in the Colony or the territorial waters thereof, and in particular the said apparatus shall be so worked as not to interrupt or interfere with the transmission of any messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea.

(2) No apparatus for wireless telegraphy on board a merchant ship shall be worked or used whilst such ship is in any of the harbours of this Colony except with the special or general permission of the Governor.

(3) If at any time, in the opinion of the Governor, an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy, the use of wireless telegraphy on board merchant ships while in the territorial waters shall be subject to such further rules as may be made by the Governor from time to time, and such rules may prohibit or regulate such use in all cases as may be deemed desirable.

(4) These Regulations shall not apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

SAINT LUCIA

Wireless Telegraphy Ordinance

No. 10 of 1912.

1. This Ordinance may be cited as the Wireless Telegraphy Ordinance, 1912.

2. In this Ordinance "wireless telegraphy" means any system of communication by telegraph without the aid of any wire connecting the points from and at which the messages or other communications are sent or received: Provided that nothing in this Ordinance shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

3. (*a*) A person shall not establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy in any place or on board any ship registered in the Colony except under and in accordance with a licence granted in that behalf by the Governor.

(*b*) Every such licence shall be in such form and for such period as the Governor may determine, and shall contain the terms, conditions and restrictions on and subject to which it is granted.

4. A person shall not work any apparatus for wireless telegraphy installed on any merchant ship, whether British or foreign, while that ship is in the territorial waters of the Colony, otherwise than in accordance with regulations under this Ordinance.

5. (*a*) The Governor may from time to time make regulations for carrying into effect the purposes of this Ordinance, and such regulations shall on publication in the *Gazette* have the same effect as if enacted in this Ordinance.

(*b*) The regulations in the Schedule to this Ordinance shall have effect except in so far as they may be amended or rescinded by regulations made under the authority of this section.

(*c*) If at any time, in the opinion of the Governor, an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy, the use of wireless telegraphy on board merchant ships while in the territorial waters of the Colony shall be subject to such further regulations as may be made by the Governor from time to time, and such regulations may prohibit or regulate such use in all cases or in such cases as may be deemed desirable.

6. If a Magistrate is satisfied by information on oath that there is reasonable ground for suspecting that a wireless telegraph station has been established without a licence in that behalf, or that any

apparatus for wireless telegraphy has been installed or worked in any place or on board any merchant ship without a licence in that behalf or contrary to the provisions of any regulations made under this Ordinance or of any licence granted under this Ordinance, he may grant a search warrant to any police officer or any person appointed in that behalf by the Chief of Police and named in the warrant, and a warrant so granted shall authorise the police officer or person named therein to enter and inspect the station, place or ship and to seize any apparatus which appears to him to be used for wireless telegraphy therein.

7. (*a*) Any person who shall offend against any provision of this Ordinance or any of the regulations made thereunder shall be liable on summary conviction for every such offence to a fine not exceeding fifty pounds, and upon such conviction the Court may order that any apparatus for wireless telegraphy in connection with which the offence was committed shall be seized and forfeited.

(*b*) Proceedings shall be taken before the First District Court on the complaint of the Chief of Police or of any person thereto authorised by him in writing, and the procedure shall be the same as the procedure for the time being in force in respect of offences punishable on summary conviction.

8. The Wireless Telegraph Ordinance, 1903, is hereby repealed.

SCHEDULE—SECTION 5 (2).

Regulations

1. All apparatus for wireless telegraphy on board a merchant ship in the territorial waters of the Colony shall be worked in such a way as not to interfere with

(*a*) Naval signalling, or

(*b*) the working of any wireless telegraph station lawfully established, installed or worked in the Colony or the territorial waters thereof; and in particular the said apparatus shall be so worked as not to interrupt or interfere with the transmission of any wireless messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea.

2. In these Regulations "naval signalling" means signalling by means of any system of wireless telegraphy between two or more ships of His Majesty's Navy, between ships of His Majesty's Navy and naval stations, or between a ship of His Majesty's Navy or a naval station and any other wireless telegraph station whether on shore or on any ship.

3. No apparatus for wireless telegraphy on board a merchant ship shall be worked or used while such ship is in any harbour or bay of the Colony except with the special or general permission of the Governor.

4. For the purpose of any proceedings under these regulations the master or person being or appearing to be in command or charge of any ship shall be deemed to have authorised and to be responsible for the use or working of any apparatus on board such ship.

5. Any summons or other document in any proceedings under these regulations shall be deemed to have been duly served on the person to whom the same is addressed by being left on board the ship on which the offence is charged to have been committed with the person being or appearing to be in charge or command of the ship.

6. These regulations shall not apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

Passed the Legislative Council this 25th day of November, 1912.

SAINT VINCENT

18TH FEBRUARY, 1904.

1. In this Ordinance the term "Wireless Telegraphy" means any system or installation designed or constructed for the transmission or receipt of any messages or communications to or from a distant place by means of electric currents and signals generated by any apparatus or instrument, which system, installation or instrument is unconnected by wire or other tangible attachment with such distant place. The term "Wireless Telegram" means any message or communication transmitted, or intended for transmission, by Wireless Telegraphy.

2. The Governor in Council and the servants of the Government of the Colony, shall have the exclusive privilege of installing, erecting, maintaining and using in this Colony apparatus intended for Wireless Telegraphy, and also the incidental services of transmitting, receiving, collecting or delivering Wireless Telegrams.

3. It shall not be lawful for any person to instal, erect, maintain or use in this Colony any apparatus or instrument for the purpose of Wireless Telegraphy without having previously obtained from the Governor a licence in that behalf to be granted on such terms and conditions as the Governor may prescribe.

4. Any person contravening the provisions of this Ordinance shall be liable on conviction to a fine not exceeding Fifty Pounds or in default of payment thereof to imprisoment with or without hard labour for any term not exceeding four months, and the apparatus and installation in respect of which a conviction is obtained may, by order of the Magistrate before whom such conviction is obtained, be forfeited to the use of His Majesty the King.

5. All proceedings under this Ordinance may be taken before the Magistrate of the First District or any other person appointed by the

Governor for the purpose of hearing and deciding the case; and the mode of procedure shall be according to the law in force for the time being regulating the proceedings before Justices.

6. This Ordinance may be cited as "The Wireless Telegraph Ordinance, 1904."

AN ORDINANCE TO AMEND THE WIRELESS TELEGRAPHY ORDINANCE, 1904.

1. (1) This Ordinance may be cited as "The Wireless Telegraph Amendment Ordinance, 1912," and shall be read as one with "The Wireless Telegraph Ordinance, 1904," and may be cited therewith as the Wireless Telegraph Ordinances, 1904 and 1912.

(2) "The Wireless Telegraph Ordinance, 1904," is herein referred to as the principal Ordinance.

2. The Governor in Council may make regulations—

(*a*) Prescribing the form and manner in which applications for licences under the principal Ordinance are to be made and the fees payable on the grant of any such licence;

(*b*) Governing the use of wireless telegraph apparatus on merchant ships, whether British or foreign, while in the territorial waters of the Colony; and

(*c*) Generally for the purpose of carrying the principal Ordinance into effect.

3. Any person committing a breach of any regulation made under this Ordinance shall be liable, on summary conviction, to a fine not exceeding £20.

SEYCHELLES ISLANDS

1. (1) No telegraphic or electrical station, apparatus, machinery, or implements whatsoever, whether for the purpose of electrical communications by what is generally known as "wireless telegraphy," or for any other purpose connected with the transmission, emission, or reception of messages between the Seychelles Islands and any place within or outside the Seychelles Islands, shall be erected or used in any place in the Seychelles Islands, whether on private property or not, without the sanction of the Administrator previously obtained.

(2) The Administrator may refuse such sanction or grant it under such conditions or restrictions as he may think fit.

(3) The word "place" in sub-section (1) shall include any ship or floating conveyance within or without the Seychelles waters, except vessels of His Majesty's Navy.

2. Any person contravening any of the provisions of this Ordinance shall be guilty of an offence and shall be liable, on prosecution

before the Court of Seychelles, to a fine not exceeding 5,000 rupees (Rd. 5,000), and every apparatus, machinery, or implement used in, or connected with, the commission of the offence shall be forfeited.

3. The Court may further order, on the application of the Crown Prosecutor, or of any person authorised by the Administrator to that effect, the immediate destruction, pulling down, or removal of any building, apparatus, machinery, or implements used in the commission of the offence.

4. All prosecutions against this Ordinance shall be instituted at the instance of the Crown Prosecutor or Inspector of Police or any person authorised by the Administrator to that effect.

5. This Ordinance may be cited as "The Telegraphic and Electrical Stations Ordinance, 1903."

SIERRA LEONE

AN ORDINANCE TO AMEND "THE WIRELESS TELEGRAPH ORDINANCE, 1903," REGULATIONS.

No. 19 of 1912.

BE it enacted by the Governor of the Colony of Sierra Leone, with the advice and consent of the Legislative Council thereof, as follows :—

1. This Ordinance may be cited as the Wireless Telegraphy Amendment Ordinance, 1912.

2. (1) A person shall not work any apparatus for wireless telegraphy installed on a merchant ship, whether British or foreign. whilst that ship is in the territorial waters of the Colony, otherwise than in accordance with the regulations contained in the Schedule to this Ordinance.

(2) The Governor-in-Council may amend, vary or revoke any of the regulations contained in the Schedule to this Ordinance and may make any other regulations, and such last-mentioned regulations shall be of the same effect as if they were contained in this Ordinance.

3. Any person acting in contravention of any regulation contained in or made under this Ordinance, shall be guilty of an offence and, on summary conviction thereof, shall be liable to a penalty not exceeding One hundred pounds, or to imprisonment, with or without hard labour, for any period not exceeding Twelve calendar months.

The Schedule.

(1) All apparatus for wireless telegraphy on board a merchant ship in the territorial waters of the Colony shall be worked in such a way as not to interfere with (*a*) naval signalling, or (*b*) the working of any wireless telegraph station lawfully established, installed or worked in the Colony or the territorial waters thereof, or in the

Protectorate, and in particular, the said apparatus shall be so worked as not to interrupt or interfere with the transmission of any messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea.

(2) No apparatus for wireless telegraphy on board a merchant ship shall be worked or used whilst such ship is in any of the harbours of the Colony, except with the special or general permission of the Governor.

(3) If at any time, in the opinion of the Governor, an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy, the use of wireless telegraphy on board merchant ships, while in the territorial waters, shall be subject to such further rules as may be made by the Governor-in-Council from time to time, and such rules may prohibit or regulate such use in all cases or in such cases as may be deemed desirable.

(4) These regulations shall not apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

Passed by the Legislative Council the 22nd of November, 1912.

SOMALILAND PROTECTORATE

1. This Ordinance may be cited as "The Wireless Telegraphs Ordinance, 1908."

2. No person shall use or establish any apparatus or installation for the purpose of operating wireless telegraphs without a licence from the Commissioner.

Any person contravening the terms of this section shall be liable on conviction to a fine not exceeding £100, or to imprisonment for a term not exceeding twelve months with or without hard labour; and any apparatus or installation in respect of which an offence under this section is committed may be forfeited and sold or disposed of as the Commissioner may direct.

3. It shall be lawful for the Commissioner from time to time by rules to prescribe the terms and conditions upon which licences to use or establish apparatus or installations for the purpose of operating wireless telegraphs may be granted.

SOUTHERN RHODESIA

1. The term "electric telegraph" whenever used in the "Electric Telegraph Act, 1861," or any law amending the same or relating to "electric telegraphs," shall be interpreted as including any system or means of conveying signs, signals, or communications by electricity, magnetism, electro-magnetism, or other like agency, and whether with or without the aid of wires; and including the system commonly

known as wireless telegraphy, or aetheric signalling, and any improvements or developments of such system; and the term "line of electric telegraph" shall be interpreted as including any apparatus, instrument, mast, standard, wire, substance, matter, or thing whatever, which is, or may be, used for the purpose of sending, transmitting, conveying, or receiving such signs, signals, or communications.

2. The meaning of the term "person" shall be further extended so as to include individuals, partnerships, companies, and corporations.

3. The provision of the first section of the said Act as to its application to Southern Rhodesia shall be read and construed as including the territorial waters thereof.

4. Within Southern Rhodesia, or the territorial waters thereof, no person not thereto expressly authorised by some law shall erect or make use of any mast, standard, or apparatus of any kind, for the purpose of signalling without wires by means of electricity, magnetism, electro-magnetism, or other like agency, or shall erect or construct any line of electric telegraph, except under a licence to be granted by the Administrator.

5. The Administrator may authorise the issue of a licence for the establishment or use of any apparatus or installation for the transmission of signs, signals, or communications, by electric telegraph, with or without the aid of wires, and may revoke the same at any time, and there shall be payable annually in respect of such a licence, such sum not exceeding One Hundred Pounds sterling, as may be fixed by regulation.

6. The terms and conditions of such licence, and the duration thereof, shall be subject to such regulations as may from time to time be made by the Administrator.

7. Any person who shall establish or use, or attempt to establish or use, any such apparatus or installation as is mentioned in Sections 1 and 4 of this Ordinance, in contravention of the provisions thereof, or of any other law relating to electric telegraphs, or of any regulation thereunder, shall be liable upon conviction to forfeit all apparatus so used, and to a penalty not exceeding Two Hundred and Fifty Pounds, and, in default of payment, to imprisonment, with or without hard labour, for a period not exceeding three months, and, in case of a second or subsequent conviction, in addition to such forfeiture to a penalty not exceeding Five Hundred Pounds, or in default of payment to imprisonment, with or without hard labour, for a period not exceeding six months.

8. Any Magistrate or Justice of the Peace before whom information shall be given on oath by credible persons, that the provisions of this Ordinance are being, or have been, or are likely to be infringed,

may issue a search warrant, and authorise the seizure of any instruments, apparatus or appurtenances reasonably suspected to be intended for use in such contravention.

9. Notwithstanding the provisions of Section 4 of "The Electric Telegraph Act, 1861," all regulations made under the authority of that Act shall be published in the *Gazette*, and be subject, *mutatis mutandis*, to the provisions of Section 7 of Act No. 5 of 1883 of the Cape of Good Hope.

10. This Ordinance may be cited as the "Electric Telegraph Amendment Ordinance, 1904," and shall be read as one with "The Electric Telegraph Act, 1861," of the Cape of Good Hope, and the "Telegraph Protection Ordinance, 1901," and the said laws may be cited together as the "Electric Telegraph Laws, 1861 to 1904."

SOUTH NIGERIA

1. This Ordinance may be cited as "The Wireless Telegraphy Ordinance."

2. No person shall establish or use any apparatus or installation whatsoever for the purpose of or in any way connected with electrical communication by any system of wireless telegraphy without previously obtaining from the Governor a licence setting forth the terms and conditions upon which the same is granted.

3. Any person infringing any of the provisions of the previous section shall be liable upon summary conviction before the Chief Justice, or a Judge of the Supreme Court, to a penalty not exceeding £1,000, or imprisonment for twelve months.

4. The Governor may from time to time by Order in Council, prescribe the terms and conditions upon which, if at all, such licences will be granted.

Amending Ordinance.

1. This Ordinance may be cited as the Wireless Telegraphy (Amendment) Ordinance, 1912, and shall be read and construed as one with the Wireless Telegraphy Ordinance which is hereinafter referred to as the Principal Ordinance.

2. Section 4 of the Principal Ordinance is hereby repealed and the following section substituted therefor:—

4. The Governor in Council may, from time to time, by Order:—

(*i.*) Prescribe the terms and conditions upon which, if at all, such licences as are required by section two will be granted;

(*ii.*) make, and, from time to time, as he shall see occasion, alter or add to regulations for governing the use of all wireless telegraph apparatus on all merchant ships whatsoever while in the territorial waters of the Colony and Protectorate of Southern Nigeria.

STRAITS SETTLEMENTS

ORDINANCE 25, dated 16th December, 1912, provides for the regulation of Wireless Telegraphy :—

1. This Ordinance may be cited as "The Wireless Telegraphy Ordinance, 1912."

2. The expression "wireless telegraphy" means any system of communication by telegraph as defined by "The Telegraph Ordinance, 1895," without the aid of any wire connecting the points from and at which the messages or other communications are sent or received:

Provided that nothing in this Ordinance shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

3. The Governor may, whenever he shall deem it expedient to do so, licence the establishment of any wireless telegraph station or the installation or working of any apparatus for wireless telegraphy in any place in the Colony or on board any British ship registered in the Colony.

4. (1) No person shall establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy in any place in the Colony or on board any British ship registered in the Colony except under and in accordance with a licence granted in that behalf by the Governor.

(2) Every such licence shall be in such form and for such period as the Governor in Council may determine, and shall contain such terms, conditions and restrictions on and subject to which the licence is granted as the Governor shall consider desirable in the public interest.

5. (1) If any person establishes a wireless telegraph station without a licence in that behalf or instals or works any apparatus for wireless telegraphy without a licence in that behalf he shall be liable to a fine not exceeding one thousand dollars or to imprisonment of either description for a term not exceeding twelve months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this Ordinance except with the previous sanction of the Public Prosecutor.

(2) If a magistrate is satisfied by information on oath that there is reasonable ground for believing that a wireless telegraph station has been established without a licence in that behalf or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship within the jurisdiction without a licence in that behalf he may grant a search warrant to any police officer to

enter and inspect the station, place or ship and to seize any apparatus which appears to him to be used or intended to be used for wireless telegraphy therein.

6. (1) The Governor in Council may make regulations for all or any of the following matters:—

(*i.*) For prescribing the form and manner in which applications for licences under this Ordinance are to be made;

(*ii.*) for prescribing the fees payable on the grant of any licence;

(*iii.*) for regulating the manner in which apparatus for wireless telegraphy on board a merchant ship, whether British or foreign, in the waters of the Colony shall be worked so as to prevent interference with naval signalling or the working of any wireless telegraph station lawfully established, installed, or worked in the Colony or the waters thereof, and so as not to interrupt or interfere with the transmission of any wireless messages between wireless telegraph stations established as aforesaid on land and wireless telegraph stations established on ships at sea;

(*iv.*) for prohibiting, except with the special or general permission of the Postmaster-General of the Colony the working or using of any apparatus for wireless telegraphy on board a merchant ship, whether British or foreign, whilst such ship is in any of the harbours of the Colony;

(*v.*) for prohibiting or regulating in case at any time in the opinion of the Governor an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy on board merchant ships, whether British or foreign, in the waters of the Colony the use of wireless telegraphy on board such ships while in such waters by such further rules as the Governor may see fit to make from time to time, and either in all cases or in such cases as may be deemed desirable.

(2) Provided that no regulations made in respect of the matters described in paragraphs (*iii.*) (*iv.*) and (*v.*) of this section shall apply to the use of wireless telegraphy for the purpose of making or answering signals of distress.

7. When an applicant for a licence proves to the satisfaction of the Governor that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy a licence for that purpose shall be granted, subject to such special terms, conditions and restrictions as the Governor may think proper, but shall not be subject to any rent or royalty.

8. (1) Every omission or neglect to comply with and every act done or attempted to be done contrary to the provisions of this Ordinance or of any Regulation made thereunder, or in breach of the conditions and restrictions subject to or upon which any licence has been issued, shall be deemed to be an offence against this Ordinance, and for every such offence not otherwise specially provided for the offender shall, in addition to the forfeiture of any articles seized, be liable to a fine of five hundred dollars.

(2) All convictions, forfeitures and fines under this Ordinance or any Regulations made thereunder may be had and recovered before a district court.

UGANDA PROTECTORATE

1. This Ordinance may be cited as "The Wireless Telegraphs Ordinance, 1908."

2. No person shall use or establish any apparatus or installation for the purpose of operating wireless telegraphs without a licence from the Governor.

Any person contravening the terms of this section shall be liable on conviction to a fine not exceeding Rs. 1,500 or to imprisonment of either kind for a term not exceeding twelve months, and any apparatus or installation in respect of which an offence under this section is committed may be forfeited and sold or disposed of as the Governor may direct.

3. It shall be lawful for the Governor from time to time by rules to prescribe the terms and conditions upon which licences to use or establish apparatus or installations for the purpose of operating wireless telegraphs may be granted.

WIRELESS TELEGRAPH STATIONS OF THE WORLD

A. Land Stations
B. Ship Stations

THE tables of land and ship stations set out in the following pages should be consulted in conjunction with the map of wireless telegraph stations of the world which is issued with this volume. The stations have been grouped together under the names of the countries in which they are established, and these countries have been arranged in alphabetical order; therefore no difficulty should be experienced in locating any particular station. The same method of classification has been adopted in regard to the ship stations.

The call letter of every station is given. Recently, however, the International Bureau has allotted a revised list of combinations and call letters to signatories of the Convention, and on p. 286 is published the list of call letters which have been reserved for the exclusive use of the respective countries. Other particulars include the normal ranges of the stations in kilometres, the wave-lengths employed, and the charges, where these have been fixed. The nature of the service carried on at the stations, and the hours during which they are open for public business are also given. Where reference numbers are given in any of the columns the notes at the end of the sections should be consulted.

With the rapidly-increasing number of installations, especially on ships, the information in this section cannot be complete at the time of publication, but every care has been taken to make the lists as complete and as accurate as possible, and they should be found reliable for ordinary requirements.

Stations which are of a private or experimental character have not been included in the lists, except where the information available has been such as to justify their inclusion. Naval and military stations have been dealt with in a like manner.

A.—LAND STATIONS

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
ARGENTINE							
Bernal	MBL	—	—	Commercial	—	—	—
AUSTRALIA							
Adelaide	POA	300	*	General public	Undefined	6d.	—
Brisbane	POB	300	*	General public	Undefined	6d.	—
Hobart	POH	300	*	General public	Undefined	6d.	—
Melbourne	POM	300	*	General public	Continuous	6d.	—
Perth, Fremantle	POP	1,250	*600*, 1,600, 2,100, 2,300	General public	Undefined	6d.	—
Sydney, Pennant Hills	POS	1,250	*600*, 1,600, 2,100, 2,300	General public	8 a.m. to midnight	6d.	—
AUSTRIA-HUNGARY							
Castelnuovo [8]	LRC	—	—	Official	Permanent	—	—
Fiume	HF	—	300–2,000	Government	—	—	—
Pola	LRP	500	600	General	Permanent	0.20	2.00
Sebenico	LRS	500	300–*600*.	General	Permanent	0.20	2.00
BELGIUM							
Antwerp	QR	—	—	Private station.	—	—	—
Nieuport	OST	400	120 [9], 300, *600*	General	Permanent	0.20 [10]	2.00 [10]
BRAZIL					Rio time.		

Poldhu Station Buildings and one of the New Masts.

[To face page 188

Babylonia (Rio de Janeiro)	BYN	200	300	General	6 a.m. to 12 midnight	0.60 [12]	6.00 [12]
Cap S. Thome	SPT	500	600	General public	Permanent	0·60	6·0
Fernando de Noronha	FNR	400 and 1,000	*600*, 1,800	General	Permanent	0.60 [13]	6.00 [13]
Guaratiba [14 15]	GRT	50.	300	Official	—	—	—
Ilha das Cobras [14]	ICL	200	300	Official	—	—	—
Juncçao	SPJ	500	600	General public	6 a.m. to midnight	0·60	6·0
Lagôa	SPL	600	1,400	General public	6 a.m. to midnight	0·60	6·0
Mánaos	MS	—	—	Railway Co.	—	—	—
Mocangue [14]	MCG [16]	50.	300	Official	—	—	—
Monte Serrat	SRT	200	300	General public	Permanent	0·60	6·0
Olinda	OLD	500	600	General	6 a.m to 12 p.m. [17]	0.60 [18]	6.00 [18]
Ponta Negra [14 15]	PNA	50.	300	Official	—	—	—
Porto Velho	MR	—	—	Operated by Madeira-Mamoré Railway Co.	—	—	—
Raza [14 15]	RZA	200	300	Official	—	—	—
Villegaignon [14]	FVG	50.	300	Official	—	—	—
BULGARIA							
Varna	FRG	500	300, 600	General public	9 a.m. to 12 a.m. 2 p.m. to 6 p.m.	0·30	3·0

* The wave-lengths used by these stations have never been officially stated by the Government, but they are believed to range between 600 and 750 metres.

Land Stations—*Continued.*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs.	Francs.
CANADA							
Belle Isle	MBL	425	600	General	Permanent	—[19]	—[19]
Camperdown (Halifax, Nova Scotia)	MHX	425	600	General [24]	Permanent	—[20]	—[20]
Cape Bear	MBE	250	300	General	Permanent [21]	—[19]	—[19]
Cape Lazo [22]	SKD	280	600	General	Permanent	0.60 [29, 30]	6.00 [29, 30]
Cape Race	MCE	650	*600*, 1,600	General	Permanent	—[26]	—[26]
Cape Ray	MCR	500	*600*, 1,600	General	Permanent [25]	—[19]	—[19]
Cape Sable	MSB	425	600	General [27]	Permanent	—[31]	—[31]
Clarks City	MCK	425	600	General	Permanent [25]	—[19]	—[19]
Dead-Tree-Point	CAD	400	600	General	8 a.m. [23] to 6 p.m.	0.60 [29]	6.00 [29]
Estevan [22]	USD	190	600	General	Permanent	0.60 [29]	6.00 [29]
Fame Point	MFP	425	600	General	Permanent [25]	—[19]	—[19]
Father Point	MUA	425	600	General	Permanent [25]	—[28]	—[28]
Grosse Isle	MGI	175	300	General	Permanent	—[28]	—[28]
Harrington	MWR	250	300	General	Permanent [25]	—[19]	—[19]
Heath Point	MHP	425	600	General	Permanent [32]	—[33]	—[33]
Ikeda Head [34]	AKD	460	600	General	8 a.m. to 12 p.m. [35]	0.60 [41]	6.00 [41]
Magdalen Islands	MUD	250	600	General	8 a.m. to 6 p.m. [36]	—[33]	—[33]
Montreal	MTL	350	600	General	Permanent [32]	—[37]	—[37]
North Sydney	MND	250	300	General	Permanent	—[33]	—[33]
Pachena [34]	KPD	460	600	General	Permanent	0.60 [41]	6.00 [41]
Partridge Island (St. John, New Bruns-	MSJ	425	600	General	Permanent	—[38]	—[38]

Pictou	MUB	175	300	General	Permanent [39]	—[33]	—[33]
Point Amour	MPR	250	300	General	Permanent	—[33]	—[33]
Point Grey [34]	PGD	190	600	General	Permanent	0.60 [41]	6.00 [42]
Point Riche	MCH	425	600	General	Permanent [32]	—[33]	—[23]
Port Arthur, Ontario	MUG	600	600	General	Permanent	—[40]	—[40]
Prince Rupert [34]	PRD	460	600	General	Permanent	0.60 [41]	6.00 [41]
Quebec	MQU [43]	175	300	General	Permanent	—[44]	—[44]
Sable Island	MSD	550	600	General [49]	Permanent	—[45]	—[45]
Three Rivers	MUC	250	600	General	Permanent [46]	—[47]	—[47]
Triangle Island [48]	TLD	650	600	General	Permanent	0.60 [55]	6.00 [55]
Victoria [48]	VSD	370	600	General	Permanent	0.60 [55 5]	6.00 [55 56]
CHILI							
Escuela Naval [50]	WEN	50	—	Excl. naval	—	—	—
Playa Ancha (Valparaiso) [51]	WFT	500	400, *700*	Excl. naval, except distress signals [52]	Permanent	—	—
Salinas (Las) [53]	WLS	20	—	Excl. naval	—	—	—
Talcahuano [54]	WTA	—	600, *700*, 1200	Naval	Permanent	—	—
CRYLON							
Colombo	CLO	720	600	General public	Permanent	0·35	—
COCOS-KEELING ISLES							
Cocos [57]	MKI	250	*300*, 600	General	Permanent	0.60	—

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
CURACAO (Colony of)					Local time.		
Curacao	CRC [61]	500	600	General [60]	5 a.m. to 7 p.m., and at 12 p.m. Sundays, 5 a.m. to 6 p.m., and at 12 a.m. midday, 6 p.m. to 7 p.m., and at 12 midnight	0.60	—
DENMARK							
Blaavands Huk [58]	BH	60.	200	—[59]	Permanent	—	—
Copenhagen	GRA	400	300, *600*	General	Permanent	0.15	—
Drogden [58]	DN	30.	300	—[59]	Permanent	—	—
Gedser [58]	N	50.	250	—[59]	Generally permanent	—	—
Gedser Haven [58]	N	50.	250	—[59]	Generally permanent	—	—
Graadyb [58]	GD	60.	200	—[59]	Permanent	—	—
Horns Rev [58]	HR	60.	200	—[59]	Permanent	—	—
Vyl [58]	VL	60.	200	—[59]	Permanent	—	—
DUTCH INDIES							
Sabang	SAB	750	450, *600*	General	Permanent	0.40	4.00
EGYPT							
Port Said	LLP	400	300, 600	General public	Permanent	0·60	—

FIJI ISLES							
Labasa	LBA	525	300, 450, 600	General public	—	0·60	—
Suva	SVA	500	300, 450, 600	General public	—	0·60	—
Tavenui	TAV	350	300, 450, 600	General public	—	0·60	—
FRANCE					W. Europe hours.		
Ajaccio	TAF [66]	700	600	General	7 a.m. to 10 p.m.	0.40 [67]	— [67]
Boulogne-sur-Mer	UBL	300	300	General	Permanent	0.40 [65]	— [65]
Bouscat	UBT	300	300	General public	Permanent	0·40	—
Brest-Arsenal [63]	IBF	—	—	—	—	—	—
Brest-Kerlaer	TQF	700	600	General	7 a.m. to 10 p.m.	0.40	—
Cherbourg	TCF	700	600	General	7 a.m. to 10 p.m.	0.40 [65]	— [65]
Cros-de-Cagnes	UNI	300	300	General public	Permanent	0·40	—
Dieppe [64]	DP	100	400	— [64]	10 a.m. to 2 p.m. and 8.30 p.m. to 11.30 p.m.	—	—
Dunkerque	TDF	700	600	General	Permanent	0.40 [65]	— [65]
Fort-de-l'Eau	UFO	700	600 [68]	General	Permanent	0.40 [69]	— [69]
Lorient	TLF	700	600	General	7 a.m. to 10 p.m.	0.40	—
Oran	TOF	—	—	Official [70]	9 a.m. to 12 p.m.	—	—
Ouessant	UOS	700	600 [68]	General	Permanent	0.40	—
Paris, Eiffel Tower	FL	—	—	Government	—	—	—
Porquerolles	UPQ	—	300	Public service	—	—	—
Port-Vendres [71]	IVF	—	—	—	—	—	—
Rochefort	TRF	700	600	General	7 a.m. to 10 p.m.	0.40	—
S. Maries-de-la-Mer	USM	700	600 [68]	General	Permanent	0.40 [69]	— [69]
Toulon-Ecole [71]	ITF	—	—	—	—	—	—
Toulon-Mourillon	TNF	—	—	Official [70]	9 a.m. to 12 p.m.	—	—

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
GERMANY							
(a) Metropole							
Adlergrund-Lightship	FAG	100	300	Limited public *	Permanent	0.18 [3]	1.80 [3]
Amrumbank-Lightship	FAF	100	300–600	Limited public *	Permanent	0.18 [3]	1.80 [3]
Aussenjade-Lightship	FAU	100	300	Limited public *	Permanent	0.18 [3]	1.80 [3]
Borkum Riff Lightship	FBR	100	300	Limited public *	Permanent	0.18 [3]	1.80 [3]
Bremerhaven-Lloydhalle [4]	KBH	400	300	Limited public †	Permanent	0.18	1.80
Bülk	KBK	200	300	General	Permanent	0.18	1.80
Cuxhaven	KCX	200	600	General	Permanent	0.18	1.80
Dantzig	KDG	600 day 1,200 night	600	General public	6 a.m. to midnight	0·18	1·80
Eider-Lightship	FIF	120	300–600	Limited public *	Permanent	0.18 [3]	1.80 [3]
Elbe Lightship No. 1	FEF	65	300	Limited public *	Permanent	0.18 [3]	1.80 [3]
Heligoland	KHG	200	300	Limited public ‡	Permanent	0.18	1.80
New Borkum Lighthouse	KBM	175	300	General	Permanent	0.18 [3]	1.80 [3]
Norddeich	KND	500–600	600	General [5]	Permanent	0.18	1.80
Sassnitz	—	200	—	Limited public	Permanent	0·18	1·80
Swinemünde	KSW	600 day 1,200 night	600	General public	6 a.m. to midnight	0·18	1·80
Weser Fireship	FWF	65	300	Limited public *	Permanent	0.18 [6]	1.80 [6]
(b) Protectorate							
Angaur [7]	KAN	500	600–850	General	8 a.m. to 9 p.m., 2 p.m. to 3	0.60	6.00

					p.m. (Shanghai time)		
Jap[7] . . .	KJA .	500 .	600–800.	General . .	8 a.m. to 9 p.m., 2 p.m. to 3 p.m. (Shanghai time)	0.60	6.00
Lüderitzbucht . .	KLÜ .	800 day 1,600 night	600 .	General public	9 a.m. to 12 a.m., 3 p.m. to 6 p.m.; Sunday, 4 p.m. to 6 p.m.	0·35	—
Swakopmund . .	KSK .	800 day 1,600 night	600 .	General public	9 a.m. to 12 a.m., 3 p.m. to 6 p.m. Sunday, 4 p.m. to 6 p.m.	0·35	—
Tsingtau (Signalberg)	KTS .	200 .	600 .	General . .	Permanent .	0.18	1.80
GIBRALTAR							
Gibraltar (Windmill Hill)	SMP[72]	—	—	Excl. naval, except in cases of distress .	—	—	—
GREAT BRITAIN							
Aberdeen . .	QBV[72]	—	—	Excl. naval ‖ .	—	—	—
Alderney. . .	QDH[72]	—	—	Excl. naval ‖ .	—	—	—
Bolt Head[73] . .	GBA .	160 .	600 .	General . .	Permanent .	0.60[74] 0.30[76] 0.15[77]	—[74] 1.80[76] 1.50[77]

* Urgent cases in connection with shipping service.
† For shipping service of North German Lloyd and limited reception of radiotelegrams.
‡ For fishing vessels and coasting steamers. ‖ Except in cases of distress.

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs.	Francs.
GREAT BRITAIN *contd.*							
Butt of Lewis	BTL	—	Variable	Lloyd's	—	—	—
Caister-on-Sea	GCS	120	300	General	Permanent	0.60 [74] 0.30 [76] 0.15 [77]	— [74] 1.80 [76] 1.50 [77]
Cleethorpes	RJD [72]	—	—	Excl. naval *	—	—	—
Clifden, Ireland	CDN	—	—	Commercial	—	—	—
Corkbeg	RJF [72]	—	—	Excl. naval *	—	—	—
Crookhaven [73]	GCK	400	600	General	Permanent	0.60 [74] 0.30, [76] 0.15 [77]	— [74] 1.80 [76] 1.50 [77]
Cross Sand Lightship	TA	10	230	Reception and transmission signals of distress	Permanent	— [75]	— [75]
Cullercoats	GCC	400, 550	600	General	Permanent	0.60 [74] 0.30 [76] 0.15 [77]	— [74] 1.80 [76] 1.50 [77]
Culver Cliff	RQN [72]	—	—	Excl. naval *	—	—	—
Dover	RQW [78]	—	—	Excl. naval *	—	—	—
East Goodwin Lightship	TE	20	230	Distress signals	Permanent	— [79]	— [79]
Fastnet, Ireland	FNT	—	—	Lloyd's	—	—	—
Felixstowe	SCQ [78]	—	—	Excl. naval *	—	—	—
Flannon Isle	FNL	—	Variable	Lloyd's	—	—	—
Fraserburgh	MFH	—	—	Commercial	—	—	—

Guernsey . . .	GU [78].	—	—	Military * .	—	—	—
Gull Lightship .	TG .	12. .	230 .	Distress signals	Permanent .	—[79]	—[79]
Heysham Harbour .	HBR	240 .	400 .	Private (M. Rly. Co.)	—	—	—
Horsea . . .	SPC [78]	—	—	Excl. naval * .	—	—	—
Hunstanton . .	HNU	80. .	300 .	—[81]	Permanent .	—	—
Inistrahull . .	IH .	—	—	Lloyd's . .	—	—	—
Ipswich . . .	TBN [78]	—	—	Excl. naval * .	—	—	—
Jersey . . .	JE .	—	—	Excl. naval .	—	—	—
Lizard, The [80] . .	GLD [82]	120 .	300 .	General . .	Permanent .	0.60 [84] 0.30 [85] 0.15 [86]	—[84] 1.80 [85] 1.50 [86]
Lochboisdale [80]. .	GCB .	200 .	300 .	—[83]	8 a.m. to 8 p.m.	—	—
Malin Head . .	GMH	120 .	300 .	General . .	Permanent .	0.60 [84] 0.30 [85] 0.15 [86]	—[84] 1.80 [85] 1.50 [86]
Newhaven [87] . .	BNH	100 .	400 .	—[88]	10 a.m. to 2 p.m., 8.30 to 11.30 p.m.	—	—
Niton [89] . . .	GNI .	120 .	300 .	General . .	Permanent .	0.60 [90] 0.30 [91] 0.15 [96]	—[90] 1.80 [91] 1.50 [96]
North Foreland [89] .	GNF .	120 .	300 .	General . .	Permanent .	0.60 [90] 0.30 [91] 0.15 [96]	—[90] 1.80 [91] 1.50 [96]
Parkeston Quay .	PQL .	200 .	*450*, 600 [92]	Private (G.E.R.)	—	—	—
Pembroke . .	THD [93]	—	—	Excl. naval * .	—	—	—
Poldhu . . .	MPD .	—	—	Commercial .	—	—	—
Portland Bill . .	TKQ [93]	—	—	Excl. naval * .	—	—	—
Portpatrick . .	TLK [93]	—	—	Excl. naval * .	—	—	—

* Except in cases of distress.

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
Rame Head . .	TMP [93]	—	—	Excl. naval * .	—	—	—
Rosslare [89] . .	GRL [94]	120 .	300 .	General . .	Permanent .	0.60 [90] 0.30 [91] 0.15 [96]	— [90] 1.80 [91] 1.50 [96]
Rosyth . . .	TQM [93]	—	—	Excl. naval * .	—	—	—
Scilly Isles . .	TVP [93]	—	—	Excl. naval * .	—	—	—
Seaforth (Liverpool) [89]	GLV .	120 .	300 .	General . .	Permanent .	0.60 [90] 0.30 [91] 0.15 [96]	— [90] 1.80 [91] 1.50 [96]
Sheerness . .	VFM [93]	—	—	Excl. naval .	—	—	—
Skegness . .	SKE .	80. .	300 .	— [95]	Permanent .	—	—
South Goodwin Lightship	TS .	24. .	230 .	Distress signals	Permanent .	— [97]	— [97]
Sunk Lightship .	TK .	48. .	230 .	Distress signals	Permanent .	— [97]	— [97]
Tobermory [98] . .	GCA .	200 .	300 .	— [99]	8 a.m. to 8.p m.	—	—
Tongue Lightship .	TT .	12. .	230 .	Distress signals	Permanent .	— [97]	— [97]
Whitehall (London) .	QBM .	—	—	Excl. naval .	—	—	—
Wick Bay . .	—	—	—	—	—	—	—
GREECE							
Athens . . .	ACH .	—	—	Naval, except in cases of distress	—	—	—
GUIANA (British)							
Demerara . .	DMA	800 .	600 .	General [100] .	Local time. 8 a.m. to 12,	0.60	—

GULF OF GUINEA							
Isabel de Fernando Poo	EFP	250	*600*, 750, 900	General public	Permanent	0·55	5·50
INDIA (British)							
Allahabad	—	—	—	—	—	—	—
Bassein	ROB	500	960	—[101]	7 a.m. to 4 p.m.; Sundays, 8 a.m. to 9 a.m., 5 p.m. to 6 p.m. (Meridian 97° 30′ E [102])	—	—
Bombay Radio	BYR	560	300, *600*	General	Permanent	0.35	—
Calcutta	—	—	—	—	—	—	—
Calcutta Radio	WCA	500	300, *600*	General [103]	6.30 a.m. to 6.30 p.m. Meridian 82° 30⁰ E [104])	0.35	—
Delhi	—	—	—	—	—	—	—
Diamond Island	ROD	500	300, 500, *600*	General [105]	7 a.m. to 6 p.m.	0.35	—
Jask	JKR	500	300, *600*	General	6 a.m. to 12 p.m.; Sundays, 6 a.m. to 10 a.m., 4 p.m. to 7 p.m. (Local times[106])	0.40	—
Karachi	WKR	500	300, 600	General public	—	0·35	—

* Except in cases of distress.

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Minimum Charge.
						Francs.	Francs.
INDIA (British)—*contd.*							
Mergui	ROG	500	670	—[107]	8 a.m. to 3 p.m., 7 p.m. to 9 p.m.; Sundays, 8 a.m. to 10 a.m., 4 p.m. to 5 p.m.	—	—
Port Blair	ROB	500	400, *800*	—[108]	7 a.m. to 4 p.m.; Sundays, 8 a.m. to 9 a.m., 5 p.m. to 6 p.m.	—	—
Sandheads	ROS	300	300, *600*	General[109]	6.30 a.m. to 6.30 p.m. (Meridian 82° 30′ E[104])	—	—
Simla	—	—	—	—	—	—	—
Table Island	ROI	500	300, *600*	General[110]	7 a.m. to 4 p.m.; Sundays, 8 a.m. to 9 a.m., 5 p.m. to 6 p.m.	0.35	—
Victoria Point	ROV	500	300, *600*, 700	General[111]	8 a.m. to 3 p.m.; 7 p.m. to 9 p.m.; Sundays, 8 a.m. to 10 a.m., 4	0.35	—

ITALY							
Bari [117]	MSC	300	300	General	Sunrise to sunset	0.30	—
Cagliari	—	500	600-*1,200*	General public	Sunrise to sunset	0·30	—
Capo Mele	MCM	300	75, *300*	General	Permanent	0.30	—
Capo Sperone	MPN	300	75, *300*	General	Permanent	0.30	—
Forte Spuria	MFS	300	75, *300*	General	Sunrise to sunset	0.30	—
Coltano	CTO	—	—	—	—	—	—
Isola Chiesa	MBV	600	980	General	Sunrise to sunset	0.30	—
Messina [118]	M	50.	50.	Official [118]	Sunrise to sunset	—	—
Monte Cappuccini	MMP	300	75, *300*	General	Sunrise to sunset	0.30	—
Naples	MNS	450	700, *1,200*	General	Sunrise to sunset	0.30	—
Palermo	MPP	450	700, *1,200*	General	Sunrise to sunset	0.30	—
Palmaria	MPM	300	75, *300*	General	Sunrise to sunset	0.30	—
Reggio Calabria [118]	R	50.	50.	Official [118]	Sunrise to sunset	—	—
S. Maria di Leuca	MSL	300	75, *300*	General	Sunrise to sunset	0.30	—
Venezia	MZV	300	75, *300*	General	Sunrise to sunset	0.30	—
Vittoria	ICV	500	300–*600*	General public	Sunrise to sunset	0·30	—
Viesti	MVT	300	75, *300*	General	Sunrise to sunset	0.30	—
Villa San Giovanni [119]	V	50	50	Official [119]	Sunrise to sunset	—	—
ERITREA							
Massawa	MUS	—	—	—	—	—	—
JAPAN							
Choshi [120]	JCS	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —
Fukkikaku [120]	JFK	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —
Dairenwan	JDA	1,200 to 2,000	300	General public	Permanent	0·30 0·60	1·50
Osezaki [120]	JOS	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —
Otchishi [120]	JOI	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —

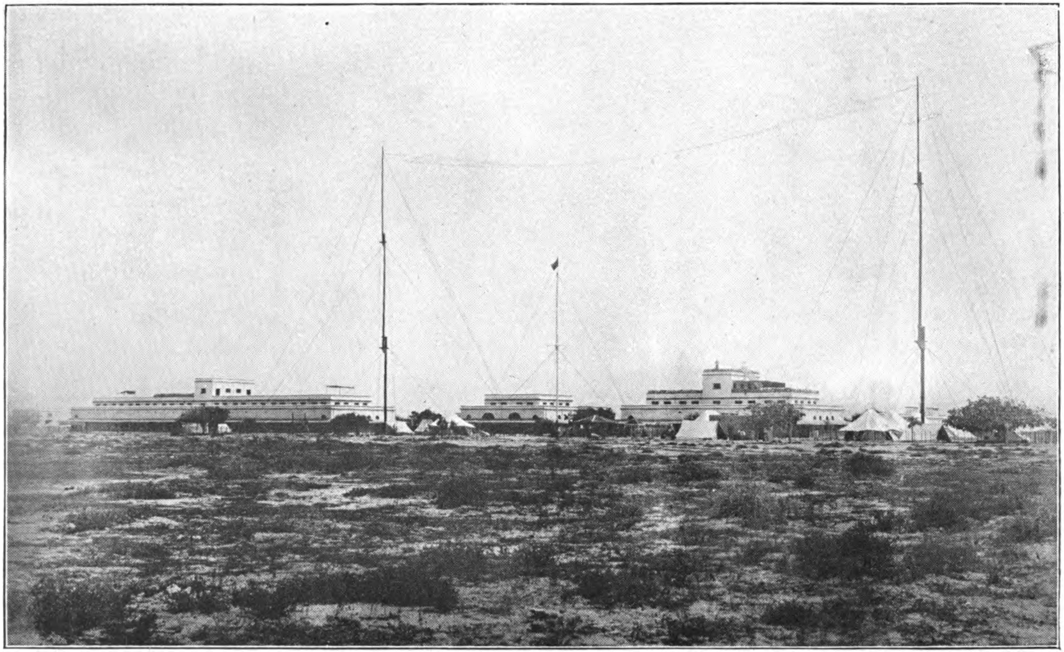
Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
JAPAN—*continued*							
Shiomisaki [120]	SM	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —
Tsunoshima [120]	JTS	1,200–2,000	300	General	Permanent	0.30 [121] 0.60 [122]	1.50 [121] —
LIBERIA							
Monravia	KAB	600 day, 1,200 night	600	General public	7 a.m. to 9 a.m., 9 p.m. to 11 p.m.	0·30	—
MADAGASCAR							
Diego-Saurez	DIO	600 day, 1,200 night	600	General public	—	0·50	—
MALTA							
Malta	TBS [123]	—	—	Excl. naval, except in cases of distress	—	—	—
MEXICO							
Bacochibampo	XCH	150	480	General public	8 a.m. to 1 p.m.	0·30	3·0
Campeche	XCP	600 day.	*600*, 900	General public	8 a.m. to 10 p.m.	0·30	3·0
Cerritos de Sinaloa	XEY	330	600, *1,600*	General [124]	8 a.m. to 1 p.m.	0.30	3.00
Isla Maria Madre	XIS	600 day.	600	General public	8 a.m. to 1 p.m.	0·30	3·0
S. Jose del Cabo	XSJ	330	600, *1,600*	General [124]	8 a.m. to 1 p.m.	0.30	3.00
S. Rosalia de la Baja California	XRH	150	480	General [124]	8 a.m. to 1 p.m.	0.30	3.00
Vera Cruz	XCZ	600 day.	*600*, 900	General public	8 a.m. to 10 p.m.	0·30	3·0

MONTENEGRO							
Antivari	AN	—	—	—	—	—	—
MOROCCO							
Casa Blanca	TPP	800	600	General public	6 a.m. to midnight	0·50	—
Ceuta	CEU	750	600, *1,200*, 1,500	Official	Permanent	—	—
Larache	CLR	500	600, *900*, 1,200	Official	Permanent	—	—
Melilla	CNE	300	300, 600, *900*, 1,200	Official	Permanent	—	—
Mogador	TYP	800	600	General public	6 a.m. to midnight	0·50	—
Rabat	TFP	200	450	Naval	—	—	—
Tangier	TWP	200	600	General public	6 a.m. to midnight	0·50	—
NETHERLANDS							
Amsterdam	ASD	—	—	Excl. naval	—	—	—
Haaks [129]	HKS	120	400	Special [126]	Permanent	—[127]	—[127]
Helder	HDR	—	—	Excl. naval	—	—	—
Hook of Holland [129]	HOK	100	300, *450*, 600	Special	—[123]	—	—
Scheveningen-Port [129]	SCH	800	*600*	General	Permanent	—	—
NEW ZEALAND							
Auckland (C.)	NZK	400	600	General public	6 a.m. to midnight	6d.	—

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Services.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
NEW ZEALAND *contd.*						Francs.	Francs.
Awanui, North Island	NZA	1,250	600, 1,600, 2,100, 2,300, 3,000	—	—	—	—
Bluff, Awarua Plains	—	—	600, 1,600, 2,100, 2,300, 3,000	—	—	—	—
Wellington, Tinakori Hills	NZW	400	600	General public	6 a.m. to mid-night	6d.	—
NORWAY							
Bergen	CRN	600	600	General public	Permanent	0·14	1·40
Flekkero	FLK	400	600	General	Permanent [125]	0.14	1.40
Ingö	NIG	900	600	General public	Permanent	0·20	2·0
Rost	RST	*60.*	600	General	9 a.m. to 1 p.m., 4 p.m. to 7.30 p.m.	0.14	1.40
Sorvaagen	SOE	60.	600	General	9 a.m. to 1 p.m., 4 p.m. to 7.30 p.m.	0.14	1.40
Spitzbergen	SBR	900	600	General public	Permanent	0·20	2·0
Tjomo	TMO	400	600	General	Permanent [125]	0.14	1.40
PORTUGAL							
Corvo	COR	120	300, *600*	General [130]	Permanent	0.60	—



Wireless Telegraph Station at Jask, Persian Gulf.

[To face page 204

Fayal	FAL	250	300, *600*	General [130]	Permanent	0.60	—
Flores	FLO	250	300, *600*	General [130]	Permanent	0.60	—
S. Maria	STM	120	300, *600*	General [130]	Permanent	0.60	—
S. Miguel	SMG	120	300, *600*	General [130]	Permanent	0.60	—
ROUMANIA							
Constantza Tunnel [131]	KST	500	600	Limited [132]	Tues. and Sat., 10 a.m. to 12 p.m.; Mon. and Fri., 1 a.m. to 12 a.m.	—[133]	—[133]
RUSSIA							
Abo	BAO	—[134]	360	—[134]	—	—	—
Anadir	RNR	240	300, 420, *600*	General public	11 a.m. to 7 p.m.	—	—
Fort Alexandrovsk	TAF	300	300, 420, *600*	General public	5.50 a.m. to 9.50 a.m., 11.50 a.m. to 3.50 p.m.	0·60	—
Helsingfors	BGF	—[134]	360	—[134]	—	—	—
Kerbinskaïa	RPN	315	—	Restricted public	—	—	—
Kronstadt	PPZ	—[134]	360	—[134]	—	—	—
Lekhte	BLH	—[134]	360	—[134]	—	—	—
Libau	BLW	—[134]	360	—[134]	—	0.4	—
Naïakhan	RNN	240	300, 420, *600*	General public	11 a.m. to 7 p.m.	0·60	—
Nicolaiewsk	NKP	450	300, *600*	General	Permanent	0.09	—
Nicolaistad	BNCh	—[134]	360	—[134]	—	—	—
Okhotsh	ROT	240	300, 420, *600*	General public	5 a.m. to 9 p.m.	0·60	—

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs	Francs.
RUSSIA—*continued*							
Petropavlovsk [135]	PRK	450	300, *600*	General	Permanent	0.60	—
Petrowsk	TPR	300	300, 420, *600*	General public	5.50 a.m. to 9.50 a.m., 11.50 a.m. to 3.50 p.m.	0·60	—
Preste	BPS	—[134]	360	—[134]	—	—	—
Reval	BRW	—[134]	360	—[134]	—	—	—
Riga	TRG	300	300, 420, *600*	General public	6 a.m. to 10 p.m.	0·60	—
Rouno	TRN	125	300, 420, *600*	General public	8 a.m. to 12 p.m., 2 p.m. to 5 p.m., 8 p.m. to 9 p.m.	0·60	—
Sebastopol	BSP	—[134]	360	—[134]	—	—	—
St. Petersburg	PTB	—	1,200	—[136]	—	—	—
Vladivostok	BWT	—[137]	1,200	—[137]	—	—	—
Vladivostok	MW	—	1,200	—[138]	—	—	—
Wiborg	WB	—	1,200	—[138]	—	—	—
SOMALILAND (British)							
Aden	ADN	320	600	General [139]	6 a.m. to 6 p.m.[144]	0.60	—
Berbera	BER	320	600	General [140]	6 a.m. to 6 p.m.[144]	0.60 [143]	—

SOMALILAND (Italian)							
Bardera	MBD	250–300 [141]	700–750	Limited [142]	Sunrise to sunset	—[141]	—[141]
Brava	MBW	250–300 [141]	700–750	Limited [142]	Sunrise to sunset	—[141]	—[141]
Giumbo	MGO	250–300 [141]	700–750	Limited [142]	Sunrise to sunset	—[141]	—[141]
Itala	MIT	250–300 [141]	300	Limited	Sunrise to sunset	—[141]	—[141]
Lugh	MLU	250–300 [141]	300	Limited [142]	Sunrise to sunset	—[141]	—[141]
Merka	MEK	250–300 [141]	300	Limited [142]	Sunrise to sunset	—[141]	—[141]
Mogadiscio	MGD	250–300 [141]	300	Limited [142]	Sunrise to sunset	—[141]	—[141]
SOUTH AFRICA, UNION OF							
Capetown	CTN	640	300–*600*	General	Permanent	0.60	—
Durban	DBN	460	300–*600*	General	Permanent	0.60	—
SPAIN							
Barcelona	EAB	1,600	300, *600*, 2,540	General public	Permanent	0·45	4·50
Cadiz	—	12	70	Private business	—	—	—
Las Palmas	EAL	1,600	300, *600*, 2,540	General public	Permanent	0·45	4·50
Madrid (Aranjuez)	MDQ	800	300, *600*, 2,130	General public	Permanent	0·45	4·50
Matagorda	—	12	70	Private business	—	—[62]	—[62]
Soller (Balearic Isles)	EAO	500	300, *600*	General public	Permanent	0·45	4·50
Teneriffe	EAT	1,600	300, *600*, 2,540	General public	Permanent	0·45	4·50
Vigo	EAV	800	300, *600*, 2,900	General public	Permanent	0·45	4·50
SWEDEN							
Gothenburg	GSG	1,200	600 rec. 1,650 trans.	General	7 a.m. to 9 p.m.	0.14	1.40

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
SWEDEN—*continued*						Francs.	Francs.
Karlskrona	GSK	800	600	General	8 a.m. to 8 p.m.	0.14	1.40
Trälleborg	CTR	500	300, *450*, 600	Special and limited public	Permanent	0·14	1·40
TUNIS							
Bizerte	TZF	—	—	Special [145]	9 a.m. to 12 mid-night	—	—
UNITED STATES							
Arlington, Va.	NAV	—	—	Government (Navy)	—	—	—
Astoria, Oreg.	KPC	320	425	Commercial	—	—	—
Avalon, Catalina Island, Cal.	KPI	—	500	Commercial	—	—	—
Baltimore,)Md.	WBS	—	—	—	—	—	—
Benton Harbour, Mich	WBN	160	Variable	Commercial	—	—	—
Boston, Mass.	WBF	—	—	—	—	—	—
Buffalo, N.Y.	WBL	120	Variable	Commercial	—	—	—
Calumet, Mich.	WCM	240	Variable	Commercial	—	—	—
Cape Cod, Mass.	WCC	—	1,500	Commercial	—	—	—
Cape Cod, South Well-fleet, Mass.	WCC	—	—	Commercial	—	—	—
Cape Hatteras, N.C.	WHA	720-1,600	600	Commercial	—	—	—
Cape May, N.J.	WCY	—	—	Commercial	—	—	—
Chicago, Ill.	WGO	—	900	Commercial	—	—	—
Cleveland, Ohio	WCX	240	Variable	Commercial	—	—	—

Detroit, Mich.	WDR	—	Variable	Commercial	—	—	—
Duluth, Minn.	WDM	—	Variable	Commercial	—	—	—
Eureka, Cali.	KPM	—	425	Commercial	—	—	—
Fort Morgan, Ala.	WFM	180	350	Commercial	—	—	—
Frankfort, Mich.	WFK	240	Variable	Commercial	—	—	—
Friday Harbor, Wash.	KPD	—	—	Commercial	—	—	—
Galveston, Tex.	WGV	320–640	450	Commercial	—	—	—
Grand Haven, Mich.	WGH	160	Variable	Commercial	—	—	—
Grand Island, La.	WGW	720–1,600	1,000	Commercial	—	—	—
Grand Marais, Minn.	WGM	240	Variable	Commercial	—	—	—
Havana, Cuba	HV	—	—	—	—	—	—
Isle Royal, Mich.	WRO	—	Variable	Commercial	—	—	—
Jacksonville, Fla.	WJX	240–480	600	Commercial	—	—	—
Junean, Alaska	KDU	—	—	—	—	—	—
Ketchikan, Alaska	KPB	—	—	—	—	—	—
Los Angeles, Cal.	KEX	—	500	Commercial	—	—	—
Ludington, Mich.	WLD	240	Variable	Commercial	—	—	—
Mackinac Island, Mich.	WHQ	160	Variable	Commercial	—	—	—
Manistique, Mich.	WMX	240	Variable	Commercial	—	—	—
Manitowoc, Wis.	WMW	240	Variable	Commercial	—	—	—
Marshfield, Oreg.	KPX	—	—	Commercial	—	—	—
Milwaukee, Wis.	WME	—	900	Commercial	—	—	—
Mobile, Ala.	WMB	—	400	Commercial	—	—	—
New Orleans, La.	WHK	—	—	—	—	—	—
Point Judith, R.I.	WPJ	—	325	Commercial	—	—	—
Port Arthur, Tex.	WRU	320	450	Commercial	—	—	—
Port Morgan, Ala.	WFM	160	350	Commercial	—	—	—
Sagaponack, N.Y.	WSK	—	350	Commercial	—	—	—
San Francisco, Cal.	KPH	—	600	Commercial	—	—	—
San Luis Obispo, Cal.	KDN	—	100	Commercial	—	—	—

Land Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Mature of Services.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
UNITED STATES *contd.*						Francs.	Francs.
San Pedro, Cal.	KPJ	—	425	Commercial	—	—	—
Sault Ste. Marie, Mich.	WSI	—	1,000	Commercial	—	—	—
Savannah, Ga.	WSV	—	—	—	—	—	—
Sea Gate, N.Y.	WSE	—	350	Commercial	—	—	—
Seattle, Wash.	KPA	—	500	Commercial	—	—	—
Siasconsett, Mass.	WSC	—	350	Commercial	—	—	—
Tampa, Fla.	WPD	800-2,300	600	Commercial	—	—	—
Virginia Beach, Va.	WSY	—	—	Commercial	—	—	—
URUGUAY							
Banco Ingles	UPY	100	450, *600*	—	—	—	—
Cerrito	UMV	1,000	*600*, 1000, 1,250	General public	Permanent	0·53	5·30
Isla de Lobos	ULB	100	450, *600*	—	—	—	—
Punta del Este	MMO	—	—	—	—	—	—
WEST AFRICA, FRENCH							
Dakar	KRA	450	60.	General	Permanent	0.30	—
Port-Etienne	BLA	1,000	*600–900*.	General	Sunrise to sunset	0.30 [2]	— [2]
[illegible]	REA	1,000	*600*–1,600	Limited public [1]	Sunrise to sun-	0.30	—

WEST INDIES							
Bermuda.	QWC [112]	—	—	Excl. naval, except in cases of distress	—	—	—
Jamaica (Bowden)	JCA	320	600	General	7 a.m. to 7 p.m. (local time) [113]	0.60	6.00
Tobago	TOG	160	600	General [114]	8 a.m. to 5 p.m.; Sundays and public holidays, 8 to 12 p.m.	0.60 [116]	— [116]
Trinidad	NPG	160	600	General [115]	8 a.m. to 10 p.m.	0.60 [116]	— [116]
ZANZIBAR							
Pemba	PMB	160	600	General [146]	8 a.m. to 12 a.m., 2 p.m. to 4 p.m.	0.20	1.60
Zanzibar	ZAR	160	600	General [147]	8 a.m. to 12 a.m., 2 p.m. to 4 p.m.	0.20	1.60

NOTES

Land Stations

1. The station exchanges radiotelegrams with Port Etienne and Conakry and does not communicate with ships except in case of interruption from Dakar.

2. The station not being connected with the interior telegraphic system, radiotelegrams which are received from ships are retransmitted to Rufisque. The charge covering the transmission from Port Etienne to Rufisque is fr. 0.30 per word.

3. For the telegrams transmitted by radiotelegraphy only between the lightship and land is collected, in addition to the ordinary charge for the transmission on the land lines, a fixed charge of fr. 1 per telegram.

4. Controlled by "Norddeutscher Lloyd" at Bremen.

5.—

6. For the telegrams transmitted by radiotelegraphy only between the lightship and land is collected, in addition to the ordinary charge for the transmission on the land lines, a fixed charge of fr. 1 per telegram.

7. Controlled by the "Deutsche Sudseephosphat-Aktiengesellschaft" of Bremen.

8. In construction.

9. The wave-length of 120 metres is reserved for correspondence of the shore station with the mail boats of the Belgian Government making the passage between Ostend and Dover.

10. For the correspondence with the mail boats of the Belgian Government passing between Ostend and Dover there is no special coast tax. The total wireless charge is fixed at fr. 1.50 per radiotelegram of ten words or less plus fr. 0·10 for every additional word after ten.

11. For radiotelegrams originating at or destined to Bahia (S. Salvador) the charge covering the transmission between Amaralina and Bahia is included in the coast station charge.

12. For radiotelegrams originating at or destined to Rio de Janeiro the charge covering the transmission between Babylonia and Rio de Janeiro is included in the coast station charge.

13. For radiotelegrams originating at or destined to Fernando de

Noronha or Recife (Pernambuco) the charge covering the transmission between the coast station Fernando de Noronha and Fernando de Noronha or Recife (Pernambuco) is included in the coast station charge.

14. Naval station.

15. In construction.

16. Identical with the call letter of the British steamship *Cambria.*

17. If necessary, the hours of service are extended.

18. For radiotelegrams originating at or destined to Olinda or Recife (Pernambuco) the tax covering the transmission between the coast station Olinda and Olinda or Recife (Pernambuco) is included in the coast station charge.

19. Fr.3 for the first ten words of the text and fr.0·18 for every additional word of the text. The words of the address and the signature are not charged for.

20. Fr.6 for the first ten words of the text and fr.0·36 for every additional word of the text. The words of the address and the signature are not charged for.

21. The station is only open during the winter months—viz., from December to March.

22. The station belongs to the Canadian Government and is controlled by the Naval Department.

23. Time of the Pacific Ocean is 8 hours later than Greenwich mean-time.

24. The station also communicates with Cape Sable and Sable Island by radiotelegraphy.

25. The station is open only throughout the season of navigation—viz., April to December.

26. Fr.9 for the first ten words of the text and fr.0·54 for every additional word of the text. The words of the address and the signature are not charged for.

27. The station is also in communication with Camperdown (Halifax, Nova Scotia) by radiotelegraphy.

28. Fr.1·50 for the first ten words of the text and fr.0·09 for every additional word of the text. The words of the address and the signature are not charged for.

29. For radiotelegrams sent by or destined to the commander of a ship relating to the business of the ship, the coast station tax is fr.2·50 for the first ten words of the text and fr.0·15 for every additional word of the text. The words of the address and signature are not charged for. The preamble of such radiotelegrams must contain the indication S.B.

30. For radiotelegrams originating at or destined to vessels on the

local service between Victoria (B.C.), Vancouver (B.C.) and Seattle (U.S.A.) the coast station charge is fr.1·25 for the first ten words of the text and fr.0·10 for every additional word of the text. The words of the address and the signature are not charged for. The preamble of such telegrams must contain the indication F.B.

31. Fr.9 for the first ten words of the text and fr.0·54 for every additional word of the text. The words of the address and the signature are not charged for.

For the radiotelegrams exchanged between Cape Sable and Camperdown (Halifax, Nova Scotia) a retransmission charge is collected amounting to fr.5 for the first ten words of the text and fr.0·35 for every additional word of the text. The words of the address and the signature are not charged for.

32. The station is open only throughout the season of navigation—viz., from April to December.

33. Fr.3 for the first ten words of the text and fr.0·18 for every additional word of the text. The words of the address and the signature are not charged for.

34. The station belongs to the Canadian Government and is controlled by the Naval Department.

35. The time of the Pacific Ocean is 8 hours later than Greenwich mean-time.

36. Four hours later than Greenwich mean-time.

37. Fr. 0·90 for the first ten words of the text and fr. 0·06 for every additional word of the text. The words of the address and the signature are not charged for.

38. Fr.6 for the first ten words of the text and fr.0·36 for every additional word of the text. The words of the address and the signature are not charged for.

39. The station is only open throughout the winter months—viz., from December to March.

40. Fr.1·50 for the first ten words of the text and fr.0·15 for every additional word of the text. The words of the address and the signature are not charged for.

41. For radiotelegrams sent by or destined to the commander of a ship relating to the business of the ship the coast station charge is fr.2·50 for the first ten words of the text and fr.0·15 for every additional word of the text. The words of the address and the signature are not charged for. The preamble of such radiotelegrams must contain the indication S.B.

42. For radiotelegrams originating at or destined to ships on the local service between Victoria (B.C.), Vancouver (B.C.), and Seattle (U.S.A.) the coast station charge is fr. 1·25 for the first ten words of

the text and fr. 0·10 for every additional word of the text. The words of the address and the signature are not charged for. The preamble of such radiotelegrams must contain the indication F.B.

43. Identical with the call letter of the British ship station s.s. *Gaika.*

44. Fr.1·50 for the first ten words of the text and fr.0·09 for every additional word of the text. The words of the address and the signature are not charged for.

45. Fr.9 for the first ten words of the text and fr.0·54 for every additional word of the text. The words of the address and the signature are not charged for.

For the radiotelegrams exchanged between Sable Island and Camperdown (Halifax, Nova Scotia) a retransmission charge is collected amounting to fr.5 for the first ten words of the text and fr.0·35 for every additional word of the text. The words of the address and signature are not charged for.

46. The station is only open throughout the season of navigation—viz., from April to December.

47. Fr.0·90 for the first ten words of the text and fr.0·06 for every additional word of the text. The words of the address and signature are not charged for.

48. The station belongs to the Canadian Government and is controlled by the Naval Department.

49. The station is also in communication with Camperdown (Halifax, Nova Scotia) by radiotelegraphy

50. Naval School, small auxiliary station.

51. Naval station.

52. Public correspondence is admitted without making a coast station charge when the station is not exchanging official correspondence.

53. Small auxiliary station of the Radiotelegraphic School.

54. In construction.

55. For radiotelegrams sent by or destined to the commander of a vessel relating to the business of the vessel the coast station charge is fr.2·50 for the first ten words of the text and fr.0·15 for every additional word of the text. The words of the address and the signature are not charged for. The preamble of such radiotelegrams must contain the indication S.B.

56. For radiotelegrams originating at or destined to ships on the local service between Victoria (B.C.), Vancouver (B.C.), and Seattle (U.S.A.), the coast station charge is Fr. 1.25 for the first ten words of the text, and Fr. 0.10 for every additional word of the text. The

words of the address and the signature are not charged for. The preamble of such radiotelegrams must contain the indication F.B.

57. The station belongs to the Marconi International Marine Communication Company, of London, and the Eastern Extension Telegraph Company, of London; it is controlled by the last-named company.

58. Light-house.

59. Wireless communication with ships at sea only in case of distress.

60. The station also exchanges telegrams with Aruba and Bonaire.

61. Same call as Norwegian S.S. "Vega."

62.—

63. Experimental station, but will respond to distress calls.

64. Station belonging to the Administration of the State Railways, utilised for the working of the maritime service for ships on the service between Dieppe and Newhaven.

65. The coast tax is reduced to fr. 0.15 per word for traffic exchanged with ships having their ports of call on the coast of the English Channel or the Straits of Dover and effecting a regular service between France and England.

66. Identical with the call letter of the Russian coast station Fort d'Alexandrovsk.

67. The coast tax is reduced to fr. 0.15 per word for traffic exchanged with ships on a regular service between France on the one hand, and Corsica, Algeria, and Tunis on the other hand.

68. This station also keeps watch on a 300 metre wave length.

69. This coast tax is reduced to fr. 0.15 per word for traffic exchanged with ships on the regular service between France on the one hand and Corsica, Algeria, and Tunis on the other hand.

70. Official correspondence.

71. Opened as an experimental station, also responds to distress calls.

72. Responds to distress calls.

73. General Post Office station.

74. For radiotelegrams exchanged with all ships which are not going to or coming from a port of the United Kingdom, and for radiotelegrams exchanged with ships making regular voyages of more than 1,855 km. from or to a port of the United Kingdom.

For radiotelegrams originating at or destined to the United

Kingdom there is a charge of fr. 0.65 per word, which charge includes the coast tax and the charge for transmission on the telegraph lines.

75. In addition to the ordinary telegraphic charge there is a fixed charge of fr. 1 per radiotelegram.

76. For radiotelegrams exchanged with ships making regular voyages of more than 370 km., but not exceeding 1,855 km. from or to ports in the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.35 per word, with a minimum of fr. 2.10 per radiotelegram, which charge includes the coast tax and the charge for transmission on the telegraph lines.

77. For radiotelegrams exchanged with ships making regular voyages of 370 km. or less from a port of the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.20 per word, with a minimum of fr. 2 per radiotelegram, which charge includes the coast tax and the charge for the transmission on the telegraph lines.

78. Responds to distress calls.

79. In addition to the ordinary telegraph charge there is a fixed charge of fr. 1 per radiotelegram.

80. General Post Office station.

81. Special correspondence, including official and ordinary telegrams, is exchanged with Skegness.

82. Identical with the call letters of the Swedish ship station, s.s. "Wale."

83. Special correspondence, including official and ordinary telegrams, is exchanged with Tobermory.

84. For radiotelegrams exchanged with all ships which are not going to or coming from a port of the United Kingdom, and for radiotelegrams exchanged with ships making regular voyages of more than 1,855 km. from or to a port of the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.65 per word, which charge includes the coast tax and the charge for transmission on the telegraph lines.

85. For radiotelegrams exchanged with ships making regular voyages of more than 370 km., but not exceeding 1,855 km., from or to ports in the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.35 per word, with a minimum of fr. 2.10 per radiotelegram, which charge includes the coast tax and the charge for transmission on the telegraph lines.

86. For radiotelegrams exchanged with ships making regular voyages of 370 km. or less from a port of the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.20 per word, with a minimum of fr. 2 per radiotelegram, which charge includes the coast tax and the charge for the transmission on the telegraph lines.

87. Station belongs to the "London, Brighton and South Coast Railway Company."

88. Special correspondence with the coast station Dieppe.

89. General Post Office station.

90. For radiotelegrams exchanged with all ships which are not going to or coming from a port of the United Kingdom, and for radiotelegrams exchanged with ships making regular voyages of more than 1,855 km. from or to a port of the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom, there is a charge of fr. 0.65 per word, which charge includes the coast tax and the charge for transmission on the telegraph lines.

91. For radiotelegrams exchanged with ships making regular voyages of more than 370 km., but not exceeding 1,855 km., from or to ports in the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.35 per word, with a minimum of fr. 2.10 per radiotelegram, which charge includes the coast tax and the charge for transmission on the telegraph lines.

92. The wave length of 600 metres is only used for communication with Port Scheveningen. This communication takes place only in case of urgent need.

93. Responds to calls of distress.

94. Identical with the call letter of the Danish ship station, s.s. "Islands Falk."

95. Special correspondence, including official and ordinary telegrams exchanged with Hunstanton.

96. For radiotelegrams exchanged with ships making regular voyages of 370 km. or less from a port of the United Kingdom.

For radiotelegrams originating at or destined to the United Kingdom there is a charge of fr. 0.20 per word, with a minimum of fr. 2 per radiotelegram, which charge includes the coast tax and the charge for the transmission on the telegraph lines.

97. In addition to the ordinary telegraphic charge there is a fixed charge of fr. 1 per radiotelegram.

98. General Post Office station.

99. Special correspondence, including official and ordinary telegrams exchanged with Loch-Boisdale.

100. The station also exchanges public and official correspondence with Trinidad.

101. The station exchanges radiotelegrams with Diamond Island, Port Blair, and Table Island; it does not communicate with ships except in case of distress.

102. Burma time is 6 hours 30 minutes in advance of Greenwich mean time.

103. This station also exchanges radiotelegrams with Sandheads.

104. Time of British India is 5 hours 30 minutes in advance of Greenwich mean time.

105. This station also exchanges radiotelegrams with Bassein, Port Blair and Table Island.

106. 3 hours 51 minutes in advance of Greenwich mean time.

107. This station exchanges radiotelegrams with Victoria Point; it does not communicate with ships except in case of distress.

108. The station exchanges radiotelegrams with Bassein, Diamond Island and Table Island; it does not communicate with ships except in case of distress.

109. The station also exchanges radiotelegrams with Calcutta Radio.

110. The station also exchanges radiotelegrams with Bassein, Diamond Island and Port Blair.

111. The station also exchanges radiotelegrams with Mergui.

112. Responds to distress calls.

113. Five hours 7 minutes 10·65 seconds to the west of Greenwich.

114. The station also exchanges public and official correspondence with Trinidad.

115. The station also exchanges public and official correspondence with Tabago.

116. For radiotelegrams originating at or destined to Port of Spain (Trinité) or Scarborough (Tabago) the tax covering the transmission between the coast station and the one or the other of these localities is included in the coast tax. The tax for the transmission of radiotelegrams to other localities will be notified to the ship stations by the coast stations.

117. Belongs to the State.

118. Station controlled by the State Railway Department, exclusively for the steam ferry-boat service of the Straits of Messine.

119. Station controlled by the State Railway Department, exclusively for the steam ferry-boat service of the Straits of Messine.

120. Exploited by the Ministry of Communications.

121. For radiotelegrams originating at or destined to Japan, Chosen, Formosa and Japanese Saghalin, also those originating at or destined to Manchuria, and which are forwarded by the telegraphic service of the Empire.

122. For radiotelegrams originating at or destined to all other countries.

123. Will respond to distress calls.

124. This station also exchanges ordinary telegrams originating at or destined to Lower California.

125. The night service is effected alternately by the stations Flekkero and Tjomo. *Flekkero* is opened on the following nights: from Tuesday to Wednesday, from Thursday to Friday, and from Saturday to Sunday. *Tjomo* is opened on the following nights: from Monday to Tuesday, from Wednesday to Thursday, and from Friday to Saturday.

The service from 8 a.m. on Sunday to 8 a.m. on Monday is effected alternately by the two stations.

126. The service rendered by the station is:—(*a*) to transmit to the radiotelegraph station, Scheveningen Port, the telegrams received by means of flag signals from ships passing in sight, or to re-transmit by means of these signals to such ships the telegrams received by means of the radiotelegraphic station, Port Scheveningen; (*b*) for the meteorological service.

127. The telegrams originating at or destined to ships and routed via the Scheveningen Port station are charged only the coast tax of this station and the tax for the transmission on the lines of the telegraphic service.

128. Generally from 9 a.m. to 5 p.m., but after these hours if the exigencies of the service require it. The station is closed on Sundays.

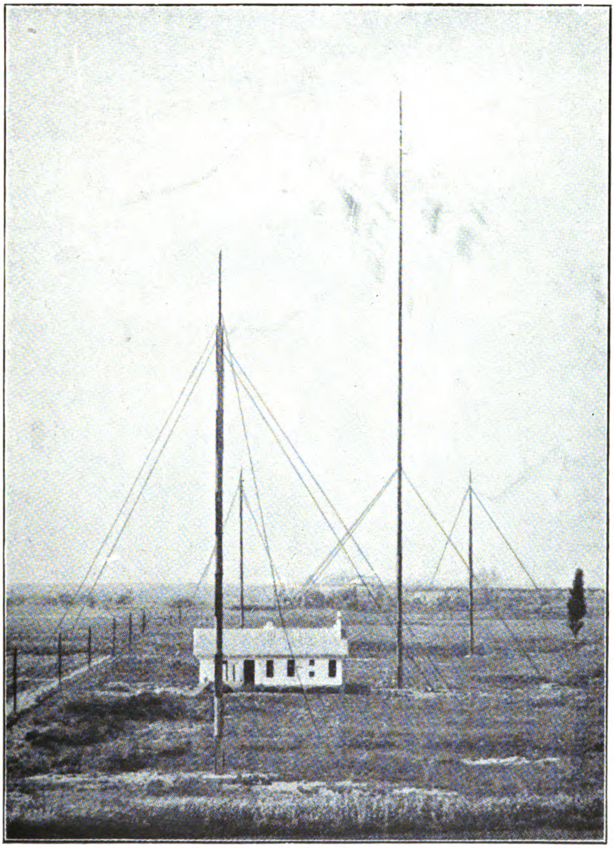
129. Controlled by the State.

130. The station also exchanges within the limits of its radius telegrams with all the other coast stations situated on the Azores.

131. Owned by "Service Maritime de L'Etat Roumain."

132. Public communication limited to the ships "Dacia," "Imparatul Traian," "Principesa Maria," "Regele Carol I.," "Romania."

133. A fixed charge of fr. 1.50 plus fr. 0.25 per word for radiotelegrams destined to the Black Sea, fr. 0.30 for those destined to the Marmora Sea, and fr. 0.35 for those destined to Aegean Sea, besides the ordinary telegraphic charge.



The Barcelona Wireless Telegraph Station (Prat de Llobregat).

[To face page 220

134. Receives only signals of distress from ships transmitting wave lengths of 300 metres at a distance from the station not exceeding 90 km., and if the ship in distress possesses a wireless station of one kilowatt power.

135. The station is not working at present.

136. Accepts exclusively radiotelegrams from ships having sustained damage.

137. Receives only the distress signals of ships transmitting wave lengths of 300 metres at a distance from the station not exceeding 90 km., and if the ship in distress possesses a wireless station of one kilowatt power.

138. Accepts exclusively radiotelegrams from ships having sustained damage.

139. The station also exchanges public and official correspondence with Berbera.

140. The station also exchanges public and official correspondence with Aden.

141. The precise indication will be published later.

142. Public correspondence limited to ship stations fitted with Marconi apparatus.

143. For radiotelegrams not originating at or destined to Berbera the coast tax is included in the charge for the transmission between Aden and Berbera.

144. The station is reopened from 8 p.m. until all traffic is disposed of.

145. Official correspondence.

146. The station also exchanges public and official correspondence with Zanzibar.

147. The station also exchanges public and official correspondence with Pemba.

SHIP STATIONS

An asterisk * against the name of the vessel denotes war vessel.

Name	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge	
						Per Word.	Minimum Charge.
						Francs.	Francs.
AUSTRIA							
Atlanta	OKA	600	300, 450, 600	General	Permanent	0.30	3.00
Columbia	OKC	600	300, 450, 600	General	Permanent	0.30	3.00
Francesca	OKF	600	300, 450, 600	General	Permanent	0.30	3.00
Sofia Hohenberg	OKH	600	300, 450, 600	General	Permanent	0.30	3.00
AUSTRIA-HUNGARY							
*Admiral Spaun	OCS	—	300, 600	Special	—	—	—
*Arpad	OBA	—	300, 600	Special	—	—	—
*Aspern	OCA	—	300, 600	Special	—	—	—
*Babenberg	OBG	—	300, 600	Special	—	—	—
*Budapest	OBU	—	300, 600	Special	—	—	—
*Csikos	OFJ	—	300, 600	Special	—	—	—
*Dinara	OFD	—	300, 600	Special	—	—	—
*Erzherzog Ferdinand Max	OBX	—	300, 600	Special	—	—	—
*Erzherzog Franz Ferdinand	OBJ	—	300, 600	Special	—	—	—
*Erzherzog Friedrich	OBI	—	300, 600	Special	—	—	—

*Gaa . . .	OGA .	—	300, *600*	Special . .		—	—
*Habsburg . .	OBH .	—	300, *600*	Special . .	—	—	—
*Herkules . .	OHK	—	300, *600*	Special . .	—	—	—
*Huszar . . .	OFH .	—	300, *600*	Special . .	—	—	—
*Kaiser Franz Joseph I.	OCF .	—	300, *600*	Special . .	—	—	—
*Kaiserin und Konigin Maria Theresia	OCM .	—	300,*600*	Special . .	—	—	—
*Kaiser Karl VI. .	OCK .	—	300, *600*	Special . .	—	—	—
*Lacroma . .	OGL .	—	300, *600*	Special . .	—	—	—
*Miramar . .	OGN .	—	300, *600*	Special . .	—	—	—
*Monarch . .	OBM .	—	300, *600*	Special . .	—	—	—
*Pandur . . .	OFP .	—	300, *600*	Special . .	—	—	—
*Pelikan . . .	OGP .	—	300, *600*	Special . .	—	—	—
*Radetzky . .	OBR .	—	300, *600*	Special . .	—	—	—
*Reka . . .	OFR .	—	300, *600*	Special . .	—	—	—
*Scharfschutze. .	OFZ .	—	300, *600*	Special . .	—	—	—
*Streiter . . .	OFX .	—	300, *600*	Special . .	—	—	—
*Szigetvar . .	OCV .	—	300, *600*	Special . .	—	—	—
*S. Georg . .	OCG .	—	300, *600*	Special . .	—	—	—
*Turul . . .	OFL .	—	300, *600*	Special . .	—	—	—
*Ulan . . .	OFN .	—	300, *600*	Special . .	—	—	—
*Uskoke . . .	OFO .	—	300, *600*	Special . .	—	—	—
*Velebit . . .	OFV .	—	300, *600*	Special . .	—	—	—
*Wien . . .	OBW.	—	300, *600*	Special . .	—	—	—
*Wildfang . .	OFW	—	300, *600*	Special . .	—	—	—
*Zenta . . .	OCZ .	—	300, *600*	Special . .	—	—	—
*Zrinyi . . .	OBY .	—	300, *600*	Special . .	—	—	—
BELGIUM							
Bruxellesville .	OQV .	300 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00

Ship Stations—*Continued*

Name	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
BELGIUM—*continued*							
Elisabethville	OSV	300	300, 450, 600	General	Permanent	0.40	4.00
Flandre (La)	ONF	100	120	Limited [3]	—	—[4]	—[4]
Jan Breydel	ONJ	100	120	Limited [3]	—	—[4]	—[4]
Lapland	ORL	300	120, 300, 600	General	—	0.40	4.00
Leopold II.	OPD	100	120	Limited [3]	—	—[4]	—[4]
Leopoldville	OPV	300	300, 450, 600	General	Permanent	0.40	4.00
Marie-Henriette	ONM	100	120	Limited [3]	—	—[4]	—[4]
Pieter de Coninck	OPK	100	120	Limited [3]	—	—[4]	—[4]
Princesse Clementine	OPC	100	120	Limited [3]	—	—[4]	—[4]
Princesse Elisabeth	OPE	100	120	Limited [3]	—	—[4]	—[4]
Princesse Henriette	OPH	100	120	Limited [3]	—	—[4]	—[4]
Princesse Josephine	OPJ	100	120	Limited [3]	—	—[4]	—[4]
Rapide (Le)	OPR	100	120	Limited [3]	—	—[4]	—[4]
Vaderland	ORD	300	120, 300, 600	General	—	0.40	4.00
BRAZIL							
Alagoas	ALG	100	300	Official	Permanent	—	—
Amazonas	AMO	100	300	Official	—	—	—
Andrade	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—

Bahia	BHI	200	400–1,200	Official	Permanent	—	—
Barroso	BRS	—	300	Official	—	—	—
Benjamin Constant	BCC	100	300	Official	—	—	—
Carlos Gomes	CGB	150	300	Official	Permanent	—	—
Deodoro	DRO	80.	300	Official	—	—	—
Floriano	FNO	80.	300	Official	—	—	—
Matto Grosso	MST	100	200	Official	—	—	—
Minas Geraes	MIG	500	300–2,100	Official	Permanent	—	—
Para	PAR	100	300	Official	—	—	—
Parahyba	PHY	100	300	Official	—	—	—
Parana	PRN	—	—	Official	—	—	—
Piauhy	PYH	100	300	Official	—	—	—
Republica	RBP	80.	300	Official	—	—	—
Rio Grande de Norte	RVG	100	300	Official	Permanent	—	—
Rio Grande de Sul	RSG	200	400–1,200	Official	Permanent	—	—
Sergipe	SGP	—	—	Official	—	—	—
S. Catharina	SCN	100	300	Official	Permanent	—	—
Tamandare	TRE	100	300	Official	Permanent	—	—
Tamoyo	TAM	—	300	Official	—	—	—
Tiradentes	TSD	30.	300	Official	—	—	—
Tupy	TPY	50.	300	Official	—	—	—
Tymbira	TYB	50.	300	Official	—	—	—
CANADA							
Aberdeen	ABD	190	300	Official	Permanent	—	—
Canada	CTD	190	300	Official	Permanent	—	—
Druid	DRD	190	300	Official	Permanent	—	—
Earl Grey	RGD	370	300	Official	Permanent	—	—
Lady Laurier	LRD	280	300	Official	Permanent	—	—
Minto	MTD	280	300	Official	Permanent	—	—
Montcalm	MLD	280	300	Official	Permanent	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range n Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word	Coast Charge. Minimum Charge.
CANADA—*continued*						Francs.	Francs.
Quadra	CGS	190	300	Official	Permanent	—	—
Stanley	STD	280	300	Official	Permanent	—	—
CHILI							
Blanco	WBL	—	—	Naval	—	—	—
Capitan Prat	WPR	—	—	Naval	—	—	—
Chacabuco	WCB	—	—	Naval	—	—	—
Esmeralda	WSM	—	—	Naval	—	—	—
General Baquedano	WGB	—	—	Naval	—	—	—
Merino Jarpa	WMJ	—	—	Naval	—	—	—
O'Brien	WBN	—	—	Naval	—	—	—
O'Higgins	WHO	—	—	Naval	—	—	—
Zenteno	WZN	—	—	Naval	—	—	—
DENMARK							
C. F. Tietgen	DCF	400	300, 450, 600	General	Permanent	0.40	4.00
Dannebrog	GRH	80.	300, 600	Naval [5]	—	—	—
Gejser	GRF	200	300, 600	Naval [5]	—	—	—
Hejmdal	GRC	400	300, 600	Naval [5]	—	—	—
Hekla	GRD	200	300, 600	Naval [5]	—	—	—
Hellig Olav	DHO	400	300, 450, 600	General	Permanent	0.40	4.00
Herluf Trolle	GRJ	200	300, 600	Naval [5]	—	—	—
Islands Falk	GRL [6]	80	300, 600	Naval [5]	—	—	—

Iver Hoitfeldt	GRI	200	300, 600	Naval [5]	—	—	—
Lovenorn	GRV	200	300, 600	General	7, 8 and 11 a.m., and 3 and 7 p.m.	—	—
Olfert Fischer	GRK	400	300, 600	Naval [5]	—	—	—
OscarII.	DOR	400	300, 450, 600	General	Permanent	0.40	4.00
Peder Skram	GRM	400	300, 600	Naval [5]	—	—	—
Skjold	GRB	100	300, 600	Naval [5]	—	—	—
United States	DUS	400	300, 450, 600	General	Permanent	0.40	4.00
FRANCE							
Algerie	RAG	500	300, 600	General	Permanent	0.40	—
Admiral Aube	ABF	700	300, 600	General	Permanent	0.05	—
Admiral Charner	ACF	700	300, 600	General	Permanent	0.05	—
Arbalete	URF	150	300	General	Permanent	0.05	—
Arc	UZF	150	300	General	Permanent	0.05	—
Arquebuse	UKF	150	300	General	Permanent	0.05	—
Atmah	AMH	100	300	General	Permanent	—	—
Baliste	UXF	150	300	General	Permanent	0.05	—
Belier	XAF	150	300	General	Permanent	0.05	—
Bombarde	XCF	150	300	General	Permanent	0.05	—
Barda	ENF	700	300, 600	General	Permanent	0.05	—
Bouclier	ZCF	150	300	General	Permanent	0.05	—
Boutefeu	YQF	150	300	General	Permanent	0.05	—
Bouvet	BOF	700	300, 600	General	Permanent	0.05	—
Bouvines	BVF	300	300, 600	General	Permanent	0.05	—
Branlebas	YBF	150	300	General	Permanent	0.05	—
Brennus	BSF	700	300, 600	General	Permanent	0.05	—
Bruix	BRF	700	300, 600	General	Permanent	0.05	—
Carabine	UPF	150	300	General	Permanent	0.05	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
FRANCE—*continued*							
Carabinier	YIF	150	300	General	Permanent	0.05	—
Carnot	COF	700	300, 600	General	Permanent	0.05	—
Carquois	XLF	150	300	General	Permanent	0.05	—
Casque	YUF	150	300	General	Permanent	0.05	—
Cassard	CSF	300	300, 600	General	Permanent	0.05	—
Cassini	CAF	300	300, 600	General	Permanent	0.05	—
Catapulte	XBF	150	300	General	Permanent	0.05	—
Cavalier	YNF	150	300	General	Permanent	0.05	—
Charlemagne	CGF	700	300, 600	General	Permanent	0.05	—
Charles-Martel	CMF	700	300, 600	General	Permanent	0.05	—
Chasseur	YGF	150	300	General	Permanent	0.05	—
Chateaurenault	CHF	700	300, 600	General	Permanent	0.05	—
Cimeterre	YOF	150	300	General	Permanent	0.05	—
Claymore	XFF	150	300	General	Permanent	0.05	—
Cognee	XRF	150	300	General	Permanent	0.05	—
Conde	CEF	700	300, 600	General	Permanent	0.05	—
Condorcet	CDF	700	300, 600	General	Permanent	0.05	—
Cosmao	CYF	300	300, 600	General	Permanent	0.05	—
Coutelas	XOF	150	300	General	Permanent	0.05	—
Dague	YPF	150	300	General	Permanent	0.05	—
Danton	DNF	700	300, 600	General	Permanent	0.05	—
Dard	UVF	150	300	General	Permanent	0.05	—
Democratie	DMF	700	300, 600	General	Permanent	0.05	—
D'Entrecasteaux	DEF	700	300, 600	General	Permanent	0.05	—
Desaix	DXF	700	300, 600	General	Permanent	0.05	—

Descartes	DAF	300	300, 600	General	Permanent	0.05	—
Diderot	DIF	700	300, 600	General	Permanent	0.05	—
Duchayla	DHF	300	300, 600	General	Permanent	0.05	—
Duguay-Trouin	EAF	700	300, 600	General	Permanent	0.05	—
Dunois	DSF	150	300	General	Permanent	0.05	—
Dupetit-Thouars	DRF	700	300, 600	General	Permanent	0.05	—
Dupleix	DUF	700	300, 600	General	Permanent	0.05	—
Dupuy de Lome	DLF	700	300, 600	General	Permanent	0.05	—
Durandal	UAF	150	300	General	Permanent	0.05	—
Edgard Quinet	EQF	700	300, 600	General	Permanent	0.05	—
Epee	UEF	150	300	General	Permanent	0.05	—
Ernest Renan	ANF	700	300, 600	General	Permanent	0.05	—
Escopette	UHF	150	300	General	Permanent	0.05	—
Espagne	RSN	300	300	General	Permanent	0.40	—
Etendard	XYF	150	300	General	Permanent	0.05	—
Fanfare	YCF	150	300	General	Permanent	0.05	—
Fanion	XZF	150	300	General	Permanent	0.05	—
Fantassin	YJF	150	300	General	Permanent	0.05	—
Fauconneau	UCF	150	300	General	Permanent	0.05	—
Faux	YSF	150	300	General	Permanent	0.05	—
Flamberge	UJF	150	300	General	Permanent	0.05	—
Fleuret	XNF	150	300	General	Permanent	0.05	—
Forbin	FBF	300	300, 600	General	Permanent	0.05	—
Formosa	RFS	500	300, 600	General	Permanent	0.40	—
Foudre	FOF	300	300, 600	General	Permanent	0.05	—
Fourche	YRF	150	300	General	Permanent	0.05	—
France	RFR	500	300, 600	General	Permanent	0.40	—
Francisque	XDF	150	300	General	Permanent	0.05	—
Friant	FTF	300	300, 600	General	Permanent	0.05	—
Furieux	FRF	300	300, 600	General	Permanent	0.05	—
Gabion	YAF	150	300	General	Permanent	0.05	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
FRANCE—*continued*						Francs.	Francs.
Galilee	GEF	300	300, 600	General	Permanent	0.05	—
Gaulois	GAF	700	300, 600	General	Permanent	0.05	—
Glaive	XPF	150	300	General	Permanent	0.05	—
Gloire	GOF	700	300, 600	General	Permanent	0.05	—
Gueydon	GDF	700	300, 600	General	Permanent	0.05	—
Guichen	GCF	700	300, 600	General	Permanent	0.05	—
Hache	XSF	150	300	General	Permanent	0.05	—
Hallebarde	UBF	150	300	General	Permanent	0.05	—
Harpon	UNF	150	300	General	Permanent	0.05	—
Henri IV.	IRF	700	300, 600	General	Permanent	0.05	—
Hussard	YHF	150	300	General	Permanent	0.05	—
Ile-de-France	RIF	300	300, 600	General	Permanent	0.40	—
Italie	RIT	500	300, 600	General	Permanent	0.40	—
Janissaire	YKF	150	300	General	Permanent	0.05	—
Jaureguiberry	JYF	700	300, 600	General	Permanent	0.05	—
Javeline	USF	150	300	General	Permanent	0.05	—
Jeanne d'Arc	JAF	700	300, 600	General	Permanent	0.05	—
Jules Ferry	JFF	700	300, 600	General	Permanent	0.05	—
Jules Michelet	JLF	700	300, 600	General	Permanent	0.05	—
Jurien de la Graviere	JUF	700	300, 600	General	Permanent	0.05	—
Justice	JSF	700	300, 600	General	Permanent	0.05	—
Kleber	GKF	700	300, 600	General	Permanent	0.05	—
La Hire	LRF	150	300	General	Permanent	0.05	—
Lansquenet	YLF	150	300	General	Permanent	0.05	—
Latouche Treville	LUF	700	300, 600	General	Permanent	0.05	—

Lavoisier	LAF	300	300, 600	General	Permanent	0.05	—
Leon Gambetta	LGF	700	300, 600	General	Permanent	0.05	—
Mameluck	YMF	150	300	General	Permanent	0.05	—
Marceau	ETF	700	300, 600	General	Permanent	0.05	—
Marseillaise	MSF	700	300, 600	General	Permanent	0.05	—
Massena	MNF	700	300, 600	General	Permanent	0.05	—
Massue	ZBF	150	150	General	Permanent	0.05	—
Mirabeau	MRF	700	300, 600	General	Permanent	0.05	—
Montcalm	MOF	700	300, 600	General	Permanent	0.05	—
Mortier	XKF	150	300	General	Permanent	0.05	—
Mousquet	ULF	150	300	General	Permanent	0.05	—
Mousqueton	UYF	150	300	General	Permanent	0.05	—
Mustapha	RMU	300	300	General	Permanent	0.10	—
Obusier	XIF	150	300	General	Permanent	0.05	—
Oriflamme	XVF	150	300	General	Permanent	0.05	—
Pampa	RPP	500	300, 600	General	Permanent	0.40	—
Parana	RPR	500	300, 600	General	Permanent	0.40	—
Patries	PRF	700	300, 600	General	Permanent	0.05	—
Pertuiane	UGF	150	300	General	Permanent	0.05	—
Pierrier	XJF	150	300	General	Permanent	0.05	—
Pique	UDF	150	300	General	Permanent	0.05	—
Pistolet	UWF	150	300	General	Permanent	0.05	—
Plata	RLA	500	300, 600	General	Permanent	0.40	—
Poignard	XQF	150	300	General	Permanent	0.05	—
Pothuau	PHF	700	300, 600	General	Permanent	0.05	—
Provence	RPV	300	300	General	Permanent	0.40	—
Rapiere	UTF	150	300	General	Permanent	0.05	—
Republique	PUF	700	300, 600	General	Permanent	0.05	—
Requin	RQF	300	300, 600	General	Permanent	0.05	—
Sabre	XEF	150	300	General	Permanent	0.05	—
Sabretache	XUF	150	300	General	Permanent	0.05	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
FRANCE—*continued*							
Sagaie	UMF	150	300	General	Permanent	0.05	—
Sape	XWF	150	300	General	Permanent	0.05	—
Sarbacane	UQF	150	300	General	Permanent	0.05	—
Sidi-Brahim	RSB	300	300,600	General	Permanent	0.10	—
Spahi	YDF	150	300	General	Permanent	0.05	—
Stylet	XGF	150	300	General	Permanent	0.05	—
Suffren	FNF	700	300, 600	General	Permanent	0.05	—
S. Louis	LSF	700	300, 600	General	Permanent	0.05	—
Tirailleur	YFF	150	300	General	Permanent	0.05	—
Trident	XMF	150	300	General	Permanent	0.05	—
Tromblon	XHF	150	300	General	Permanent	0.05	—
Vaucluse	VCF	150	300	General	Permanent	0.05	—
Vergniaud	VGF	700	300, 600	General	Permanent	0.05	—
Verite	VRF	700	300, 600	General	Permanent	0.05	—
Victor Hugo	VHF	700	300, 600	General	Permanent	0.05	—
Voltaire	VLF	700	300, 600	General	Permanent	0.05	—
Voltigeur	YEF	150	300	General	Permanent	0.05	—
Waldeck-Rousseau	WKF	700	300, 600	General	Permanent	0.05	—
Yatagan	UFF	150	300	General	Permanent	0.05	—
GERMANY							
Adeline-Hugo Stinnes III.	DAH	300	300, 450, 600	General	As required	0.40 [2]	4.00 [2]
Adler	DAD	250	300, 450, 600	General	Permanent	0.40 [2]	4.00 [2]

Admiral	DAL	600	300, 450, 600	General	Permanent	0.40	4.00
Adolf Woermann	DAW	600	300, 450, 600	General	Permanent	0.40	4.00
Aegir	AAE	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Albatross	AAK	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Alexandra Woermann	DXW	600	300, 450, 600	General	Permanent	0.40	4.00
Amazone	AAM	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Amerika	DDR	300	300, 600	General	Permanent	0.40	4.00
Annie-Hugo Stinnes VI.	DAI	150	300, 450, 600	General	As required	0.40 [2]	4.00 [2]
Arcona	AAR	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Ariadne	AAI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Augsburg	AAU	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Barbarossa	DKS	300	300, 600	General	Permanent	0.40	4.00
Batavia	DDJ	300	300, 600	General	Permanent	0.40	4.00
Beowulf	ABW	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Berengar	DBE	600	300, 450, 600	General	As required	0.40	4.00
Berlin	DKB	400	110, 300, 600	General	Permanent	0.40	4.00
Berlin	ABE	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Berthold	DBD	100	300, 600	General	6 a.m. to 7 a.m., 6 p.m. to 7 p.m.	0.40	4.00
Birkenfels [1,2]	DBF	600	300, 450, 600	General	As required	0.40	4.00
Blitz	ABZ	—	300, 600	Official	Permanent	0.40	4.00
Blücher	DDB	300	300, 600	General	Permanent	0.40	4.00
Blücher	ABL	—	300, 600	Official	Permanent	0.40	4.00

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GERMANY—*continued*						Francs.	Francs.
Brandenburg	DBG	400	300, 450, 600	General	Permanent	0.40	4.00
*Brandenburg	ABD	—	300, 600	Official	Permanent	0.40	4.00
*Braunschweig	ABR	—	300, 600	Official	Permanent	0.40	4.00
Bremen	DBR	600	300, 450, 600	General	Permanent	0.40	4.00
*Bremen	ABN	—	300, 600	Official	Permanent	0.40	4.00
Bulgaria	DDG	300	300, 600	General	Permanent	0.40	4.00
Bulow	DBW	600	300, 450, 600	General	Permanent	0.40	4.00
Burgermeister	DBM	600	300, 450, 600	General	Permanent	0.40	4.00
Cap Arcona	DCA	600	300, 450, 600	General	Permanent	0.40	4.00
Cap Blanco	DCB	600	300, 450, 600	General	Permanent	0.40	4.00
Cap Ortegal	DCO	600	300, 450, 600	General	Permanent	0.40	4.00
Cap Roca	DCR	600	300, 450, 600	General	Permanent	0.40	4.00
Cap Verde	DCE	600	300, 450, 600	General	Permanent	0.40	0.40
Cap Vilano	DCV	600	300, 450, 600	General	Permanent	0.40	4.00
Cassel	DCC	400	300, 450,	General	Permanent	0.40	4.00

Cincinnati	DDC	400	110, *300*, 600	General	Permanent	0.40	4.00
Claire-Hugo Stinnes I	DCS	300	*300*, 450, 600	General	As required	0.40	4.00
Clara Blumenfeld	DCL	300	*300*, 450, 600	General	Permanent	0.40 [2]	4.00
Cleveland	DDV	400	110, *300*, 600	General	Permanent	0.40	4.00
*Cöln	ACO	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Corcovado	DRC	350	*300*, 450, 600	General	Permanent	0.40	4.00
*Danzig	ADÄ	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Derfflinger	DER	600	*300*, 450, 600	General	Permanent	0.40	4.00
Deutschland	DDE	500	*300*, 450, 600	General	As required	0.40	4.00
*Deutschland	ADE	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Diedrich	DTD	100	*300*, 600	General	6 a.m. to 7 a.m., 6 p.m. to 7 p.m.	0.40	4.00
*Drache	ADA	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Dresden	ADR	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Eber	AEB	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Edmund-Hugo Stinnes IV.	DEH	300	*300*, 450, 600	General	As required	0.40 [2]	4.00 [2]
Eleonore Woermann	DEW	500	*300*, 600	General	Permanent	0.40	4.00
Elkab	DEB	600	*300*, 450, 600	General	Permanent	0.40	4.00
*Elsass	AEL	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Emden	AEM	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
GERMANY—*continued*						Francs.	Francs.
Feldmarschall	DFL	600	300, 450, 600	General	Permanent	0.40	4.00
*Frauenlob	AFO	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Freya	AFR	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Friedrich Carl	AFS	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Friedrich der Grosse	DKD	300	300, 600	General	Permanent	0.40	4.00
*Frithjof	AFT	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Fritz-Hugo Stinnes V	DFH	150	300, 450, 600	General	As required	0.40 [2]	4.00 [2]
Furst Bismarck	DFB	600	300, 450, 600	General	Permanent	0.40	4.00
*Furst Bismarck	ABI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Ganelon	DGA	600	300, 450, 600	General	As required	0.40	4.00
*Gazelle	AGL	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Gefion	AGF	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
General	DGL	600	300, 450, 600	General	Permanent	0.40	4.00
George Washington	DKN	400	110, 300, 600	General	Permanent	0.40	4.00
Gertrud Woermann	DGW	600	300, 450, 600	General	Permanent	0.40	4.00
Gneisenau	DGU	600	300, 450, 600	General	Permanent	0.40	4.00

*Gneisenau	AGN	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Goeben	DGN	600	300, 450, 600	General	Permanent	0.40	4.00
Graf Waldersee	DDW	300	300, 600	General	Permanent	0.40	4.00
Grete-Hugo Stinnes VIII.	DGH	175	300, 450, 600	General	As required	0.40 [2]	4.00 [2]
*Grille	AGS	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Grosser Kurfurst	DKG	400	300, 450, 600	General	Permanent	0.40	4.00
Grossherzog von Oldenburg	DGO	300	300, 600	Shipping	As required	—	—
Habsburg	DHG	600	300, 450, 600	General	Permanent	0.40	4.00
*Hagen	AHA	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Haimon	DHA	600	300, 450, 600	General	As required	0.40	4.00
Hamburg	DDH	300	300, 600	General	Permanent	0.40	4.00
*Hamburg	AHM	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hannover	AHV	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hansa	AHN	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hay	AHP	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Heimdall	AHD	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hela	AHL	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Helene Blumenfeld	DHB	350	300, 350, 450, 600	General	Permanent	0.40 [1]	4.00 [1]
*Helgoland	AHC	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Heluan	DHE	500	300, 450, 600	General	Permanent	0.40	4.00
*Hertha	AHT	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hessen	AHE	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Hildebrand	AHI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GERMANY—*continued*						Francs.	Francs.
Hohenstaufen	DHN	600	300, 450, 600	General	Permanent	0.40	4.00
*Hohenzollern	AHO	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Holger	DHR	600	300, 450, 600	General	As required	0.40	4.00
Holstein	DHL	600	300, 450, 600	General	As required	0.40	4.00
*Iltis	AIL	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Imperator	DIR	150	300, 450, 600	General	Permanent	0.18	1.80
*Irene	AIR	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Jade	AJA	150	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Jaguar	AIG	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Kaiser Barbarossa	AKB	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Kaiser Friedrich III.	AKF	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Kaiserin Augusta	AKA	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Kaiserin Auguste Victoria	DDA	300	300, 600	General	Permanent	0.40	4.00
*Kaiser Karl der Grosse	AKG	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Kaiser Wilhelm II.	DKM	600	300, 600	General	Permanent	0.40	4.00
*Kaiser Wilhelm II.	AKI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Kaiser Wilhelm der Grosse	DKW	400	300, 600	General	Permanent	0.40	4.00

*Kaiser Wilhelm der Grosse	AKW	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Kleist	DST	500	300, 450, 600	General	Permanent	0.40	4.00
Konig Albert	DKO	300	300, 600	General	Permanent	0.40	4.00
Konig Friedrich August	DFR	300	300, 450, 600	General	Permanent	0.40	4.00
Konigin Luise	DKL	300	300, 600	General	Permanent	0.40	4.00
*Konigsberg	AKO	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Konig Wilhelm II.	DDK	300	300, 450, 600	General	Permanent	0.40	4.00
Kronprinz	DPZ	600	300, 450, 600	General	Permanent	0.40	4.00
Kronprinzessin Cecilie	DKA	400	300, 600	General	Permanent	0.40	4.00
Kronprinzessin Cecilie	DCI	600	300, 450, 600	General	Permanent	0.40	4.00
Kronprinz Wilhelm	DKP	400	300, 600	General	Permanent	0.40	4.00
*Leipzig	ALE	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Lothringen	ALO	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Lübeck	ALU	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Luchs	ALU	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Lucie Woermann	DLW	500	300, 600	General	Permanent	0.40	4.00
Lützow	DLO	600	300, 450, 600	General	Permanent	0.40	4.00
Main	DKI	300	300, 600	General	Permanent	0.40	4.00
*Mecklenberg	AME	—	300, 600	Official	Permanent	0.40	4.00
*Medusa	AMD	—	300, 600	Official	Permanent	0.40	4.00
Meteor	DMR	300	300, 450, 600	General	Permanent	0.40	4.00

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GERMANY—*continued*						Francs.	Francs.
Moltke	DDM	300	300, 600	General	Permanent	0.40	4.00
*München	AMÜ	—	300, 600	Official	Permanent	0.40	4.00
*Nautilus	ANA	—	300, 600	Official	Permanent	0.40	4.00
Navarra	DNV	600	300, 450, 600	General	Permanent	0.40	4.00
Neckar	DKK	300	300, 600	General	Permanent	0.40	4.00
Negada	DNA	600	300, 450, 600	General	Permanent	0.40	4.00
*Niobe	ANI	—	300, 600	Official	Permanent	0.40	4.00
Nitokris	DNI	600	300, 450, 600	General	Permanent	0.40	4.00
Nora-Hugo Stinnes II.	DNH	300	300, 450, 600	General	As required	0.40	4.00
*Nürnberg	ANÜ	—	300, 600	Official	Permanent	0.40	4.00
*Nymphe	ANY	—	300, 600	Official	Permanent	0.40	4.00
*Odin	AOD	—	300, 600	Official	Permanent	0.40	4.00
*Ostfriesland	AOF	—	300, 600	Official	Permanent	0.40	4.00
Pallanza	DDQ	300	300, 450, 600	General	Permanent	0.40	4.00
*Panther	APA	—	300, 600	Official	Permanent	0.40	4.00
Patricia	DDP	300	300, 600	General	Permanent	0.40	4.00
*Pelikan	APE	—	300, 600	Official	Permanent	0.40	4.00
Pennsylvania	DDN	300	300, 600	General	Permanent	0.40	4.00
*Pfeil	APF	—	300, 600	Official	Permanent	0.40	4.00
Pisa	DDF	300	300, 450,	General	Permanent	0.40	4.00

Polynesia . .	DPO .	600 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
*Pommern . .	APM .	—	*300*, 600	Official . .	Permanent .	0.40	4.00
President Grant .	DDS .	300 .	*300*, 600	Public . .	Permanent .	0.40	4.00
President Lincoln .	DDI .	300 .	*300*, 600	General . .	Permanent .	0.40	4.00
Pretoria . .	DDT .	300 .	*300*, 600	General . .	Permanent .	0.40	4.00
*Preussen . .	APR .	—	*300*, 600	Official . .	Permanent .	0.40	4.00
Prinz Adalbert .	DDZ .	250 .	*300*, 600	General . .	Permanent .	0.40	4.00
*Prinz Adalbert .	AAD .	—	*300*, 600	Official . .	Permanent .	0.40	4.00
Prinz August Wilhelm	DSB .	400 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinz Eitel Friedrich	DSI .	400 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinz Eitel Friedrich	DPE .	600 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinzess Alice . .	DKZ .	300 .	*300*, 600	General . .	Permanent .	0.40	4.00
Prinzessin . .	DPN .	600 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinzess Irene . .	DKE	300 .	*300*, 600	General . .	Permanent .	0.40	4.00
*Prinzess Wilhelm .	AWL	—	*300*, 600	Official . .	Permanent .	0.40	4.00
Prinz Friedrich Wilhelm	DKF .	300 .	120, *300*, 600	General . .	Permanent .	0.40	4.00
*Prinz Heinrich .	AHR	—	*300*, 600	Official . .	Permanent .	0.40	4.00
Prinz Joachim .	DSP .	400 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinz Ludwig . .	DPL .	600 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinz Oskar . .	DDO .	250 .	*300*, 600	General . .	Permanent .	0.40	4.00
Prinzregent . .	DPG .	600 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00
Prinz Sigismund .	DSG .	400 .	*300*, 450, 600	General . .	Permanent .	0.40	4.00

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
GERMANY—*continued*						Francs.	Francs.
Rhaetia	DRE	600	300, 450, 600	General	Permanent	0.40	4.00
Rhakotis	DRH	600	300, 450, 600	General	Permanent	0.40	4.00
Rhein	DKR	300	300, 600	General	Permanent	0.40	4.00
Rhodopia	DRS	600	300, 450, 600	General	Permanent	0.40	4.00
Roda	DRA	600	300, 450, 600	General	Permanent	0.40	4.00
Roland	DRB	75	300, 450, 600	Shipping	As required	0.40	4.00
*Roon	DRN	600	300, 450, 600	General	Permanent	0.40	4.00
Roon	ARO	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Rugia	DRU	600	300, 450, 600	General	Permanent	0.40	4.00
Scharnhorst	DSA	600	300, 450, 600	General	Permanent	0.40	4.00
*Scharnhorst	ASB	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Schlesien	ASN	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Schleswig-Holstein	ASX	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Schwaben	ASA	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Schwalbe	DSL	250	300, 450, 600	General	Permanent	0.40	4.00
Schwan	DSN	250	300, 450, 600	General	Permanent	0.40	4.00

Seeadler	DSE	150	300, 450, 600	Shipping	As required	0.40	4.00
Senator Schafer	DSS	150	300, 450, 600	General	As required	0.40	4.00
Senator von Berenberg Gossler	DSD	150	300, 450, 600	General	As required	0.40	4.00
Seydlitz	DSZ	600	300, 450, 600	General	Permanent	0.40	4.00
*Siegfried	ASI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Sleipner	ASL	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Sperber	DSK	250	300, 450, 600	General	Permanent	0.40 [2]	4.00 [2]
Stephan	DSC	600	300, 450, 600	Shipping	As required	—	—
*Stettin	ASY	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Stuttgart	ASZ	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Thessalia	DTE	600	300, 450, 600	General	Permanent	0.40	4.00
*Thetis	ATH	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Thüringen	ATÜ	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Thüringia	DTU	600	300, 450, 600	General	Permanent	0.40	4.00
*Tiger	ATI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Undine	AUN	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Victoria Luise	AVL	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Vineta	AVN	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Vulkan	AVU	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Wettin	AWE	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]
Wiegand	DWI	600	300, 450, 600	General	As required	0.40	4.00
*Wittelsbach	AWI	—	300, 600	Official	Permanent	0.40 [1]	4.00 [1]

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Services.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs.	Francs.
GERMANY—*continued*							
*Wörth	AWÖ	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
*Würtemberg	AWÜ	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Yorck	DYK	600	*300*, 450, 600	General	Permanent	0.40	4.00
*Yorck	AYO	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Ypiranga	DYA	350	*300*, 450, 600	General	Permanent	0.40	4.00
*Zähringen	AZA	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
Zieten	DZN	600	*300*, 450, 600	General	Permanent	0.40	4.00
*Zieten	AZI	—	*300*, 600	Official	Permanent	0.40 [1]	4.00 [1]
GREAT BRITAIN							
Aaro	MWA	320	300, 600	General	Permanent	0.15 [2]	0.90 [2]
*Aboukir	QBD	—	—	Naval	—	—	—
*Achilles	QBK	—	—	Naval	—	—	—
Adriatic	MHC	450	300, 600	General	Permanent	0.40	—
*Adventure	QBT	—	—	—	—	—	—
Æneas	MFU	450	300, 600	General	Permanent	0.40	—
*Æolus	QCD	—	—	Naval	—	—	—
Afric	MYC	450	300, 600	General	Permanent	0.40	—
*Africa	QCK	—	—	Naval	—	—	—
*Agamemnon	QCN	—	—	Naval	—	—	—
*Alacrity	QCS	—	—	Naval	—	—	—
*Albemarle	QDC	—	—	Naval	—	—	—

*Albion	QDK	—	—	Naval	—	—	—
*Alert	QDN	—	—	Naval	—	—	—
Amazon	MBZ	450	300, 600	General	Permanent	0.40	—
*Amethyst	QFJ	—	—	Naval	—	—	—
*Amphitrite	QFL	—	—	Naval	—	—	—
Amsterdam	PQA	280	300, 450, 600[2]	Limited, Caister, North Foreland, Scheveningen	Permanent while crossing	0.10	1.00
Anchises	MFW	450	300, 600	General	Permanent	0.40	—
Andorinha	MIU	450	300, 600	General	Permanent	0.40	—
*Andromeda	QFP	—	—	Naval	—	—	—
Anselm	MDK	450	300, 600	General	Permanent	0.40	—
Antillian	MJL	450	300, 600	General	Permanent	0.40	—
Antony	MAY	450	300, 600	General	Permanent	0.40	—
Antrim	HAR	240	300, 400, 600	Limited, Seaforth	Permanent during crossing, Heysham to Belfast	0.05	0.50
*Antrim	QFW	—	—	Naval	—	—	—
Arabia	MMZ	450	300, 600	General	Permanent	0.40	—
Arabic	MFC	270	300, 600	General	Permanent	0.40	—
Aragon	MBN	450	300, 600	General	Permanent	0.40	—
Araguaya	MBG	450	300, 600	General	Permanent	0.40	—
Arawa	MWE	450	300, 600	General	Permanent	0.40	—
*Argonaut	QHP	—	—	Naval	—	—	—
*Argyll	QHS	—	—	Naval	—	—	—
*Ariadne	QHT	—	—	Naval	—	—	—
Armadale Castle	MQG	450	300, 600	General	Permanent	0.40	—
*Arrogant	QJB	—	—	Naval	—	—	—
Ascanius	MFV	450	300, 600	General	Permanent	0.40	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
Asian	MKL	450	300, 600	General	Permanent	0.40	—
Assaye	MOO	450	300, 600	General	Permanent	0.40	—
*Assistance	QJF	—	—	Naval	—	—	—
*Astraea	QJK	—	—	Naval	—	—	—
Asturias	MBB	450	300, 600	General	Permanent	0.40	—
Atahualpa	MDU	450	300, 600	General	Permanent	0.40	—
Athenia	MBA	450	300, 600	General	Permanent	0.40	—
Athenic	MWN	450	300, 600	General	Permanent	0.40	—
Atrato	UNA	300	300, 600	General	Permanent	0.40	—
*Attentive	QJP	—	—	Naval	—	—	—
Augustine	MFT	450	300, 600	General	Permanent	0.40	—
Avon	MBO	450	300, 600	General	Permanent	0.40	—
*Bacchante	QJV	—	—	Naval	—	—	—
Balmoral Castle	MPW	450	300, 600	General	Permanent	0.40	—
Baltic	MBC	450	300, 600	General	Permanent	0.40	—
*Barham	QKH	—	—	Naval	—	—	—
*Bellerophon	QKV	—	—	Naval	—	—	—
*Bellona	QKW	—	—	Naval	—	—	—
Ben-my-Chree	MBQ	120	300	Limited	Permanent during crossing, Liverpool to Douglas, I. of M.	0.05	0.50
*Berwick	QLB	—	—	Naval	—	—	—
Berwindmoor	IGQ	450	300, 600	General	Permanent	0.40	—

*Black Prince	QLJ	—	—	Naval	—	—	—
*Blake	QLK	—	—	Naval	—	—	—
*Blanche	QLM	—	—	Naval	—	—	—
*Blenheim	QLR	—	—	Naval	—	—	—
*Blonde	QLT	—	—	Naval	—	—	—
*Boadicea	QMB	—	—	Naval	—	—	—
Bohemian	MEL	450	300, 600	General	Permanent	0.40	—
*Bonaventure	QMD	—	—	Naval	—	—	—
*Brilliant	QMS	—	—	Naval	—	—	—
*Bristol	QMW	—	—	Naval	—	—	—
*Britannia	QNB	—	—	Naval	—	—	—
Briton	MQJ	450	300, 600	General	Permanent	0.40	—
Brussels	PQB	200	300, 450, 600 [7]	Limited	Permanent during crossing, Harwich to Antwerp	0.10	1.00
Buccaneer	MCT	200	300, 600	Private	—	—	—
*Bulwark	QNM	—	—	Naval	—	—	—
*Cadmus	QPC	—	—	Naval	—	—	—
*Cæsar	QPD	—	—	Naval	—	—	—
Calabria	MAJ	450	300, 600	General	Permanent	0.40	—
Caledonia	MAI	450	300, 600	General	Permanent	0.40	—
Caledonia	MNU	450	300, 600	General	Permanent	0.40	—
California	MCI	450	300, 600	General	Permanent	0.40	—
Californian	MWL	450	300, 600	General	Permanent	0.40	—
Calypso	UCO	250	300, 600	General	Permanent	0.15 [2]	0.90 [2]
Cambria	MCG [201]	240	300, 600	Private	—	—	—
*Cambrian	QPK	—	—	Naval	—	—	—
Campania	MCA	270	300, 600	General	Permanent	0.40	—
Canada	MCF	270	300, 600	General	Permanent	0.40	—
Canadian	MGL	450	300, 600	General	Permanent	0.40	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs.	Francs.
GREAT BRITAIN *contd.*							
Canopic	MPC	450	300, 600	General	Permanent	0.40	—
*Canopus	QPS	—	—	Naval	—	—	—
Carisbrook Castle	MOW	450	300, 600	General	Permanent	0.40	—
Carmania	MAA	450	300, 600	General	Permanent	0.40	—
*Carnarvon	QPV	—	—	Naval	—	—	—
Caronia	MRA	450	300, 600	General	Permanent	0.40	—
Carpathia	MPA	270	300, 600	General	Permanent	0.40	—
Carthaginian	MHN	270	300, 600	General	Permanent	0.40	—
Cassandra	MED	450	300, 600	General	Permanent	0.40	—
Cedric	MDC	450	300, 600	General	Permanent	0.40	—
Celtic	MLC	450	300, 600	General	Permanent	0.40	—
Cestrian	MHL	450	300, 600	General	Permanent	0.40	—
*Challenger	QRD	—	—	Naval	—	—	—
*Charybdis	QRM	—	—	Naval	—	—	—
China	MMU	450	300, 600	General	Permanent	0.40	—
Christopher	MDD	450	300, 600	General	Permanent	0.40	—
Clement	MDB	450	300, 600	General	Permanent	0.40	—
*Clio	QSJ	—	—	Naval	—	—	—
Clyde	UNK	300	300, 600	General	Permanent	0.40	—
*Cochrane	QSL	—	—	Naval	—	—	—
Colchester	PQO	200	300, 450, 600 [7]	Limited	Permanent during crossing, Harwich to Antwerp	0.10	1.00

*Collingwood	QSP	—	—	Naval	—	—	—
Colonia	MCL	450	300, 600	Private	—	—	—
*Colossus	QSV	—	—	Naval	—	—	—
Columbia	MOI	450	300, 600	General	Permanent	0.40	—
*Commonwealth	QTC	—	—	Naval	—	—	—
Copenhagen	PQC	280	300, 450, 600	Limited	Permanent during crossing Hook of Holland to Harwich	0.10	1.00
Corinthian	MKN	270	300, 600	General	Permanent	0.40	—
Corinthic	MWT	450	300, 600	General	Permanent	0.40	—
Cormorant	MFJ	250	300, 600	Private	—	—	—
*Cornwall	QTR	—	—	Naval	—	—	—
*Cornwallis	QTS	—	—	Naval	—	—	—
Corsican	MCN	270	300, 600	General	Permanent	0.40	—
*Crescent	QVP	—	—	Naval	—	—	—
*Cressy	QVR	—	—	Naval	—	—	—
Cretic	MRC	450	300, 600	General	Permanent	0.40	—
*Cumberland	QWM	—	—	Naval	—	—	—
*Cyclops	QWR	—	—	Naval	—	—	—
Cymric	MGC	270	300, 600	General	Permanent	0.40	—
Danube	MBM	450	300, 600	General	Permanent	0.40	—
*Dartmouth	RBJ	—	—	Naval	—	—	—
*Defence	RBS	—	—	Naval	—	—	—
Delta	MKG	450	300, 600	General	Permanent	0.40	—
Devanha	MOU	450	300, 600	General	Permanent	0.40	—
Devonian	MDL	450	300, 600	General	Permanent	0.40	—
*Devonshire	RCV	—	—	Naval	—	—	—
*Diadem	RDC	—	—	Naval	—	—	—
*Diamond	RDF	—	—	Naval	—	—	—

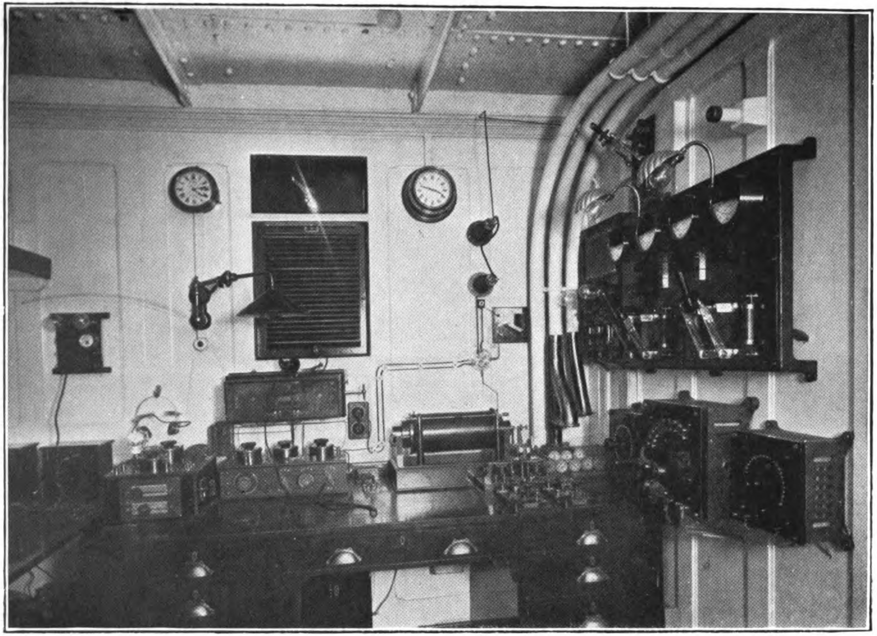
Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Services.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
*Diana	RDH	—	—	Naval	—	—	—
*Dido	RDK	—	—	Naval	—	—	—
Dominion	MDF	270	300, 600	General	Permanent	0.40	—
*Dominion	RDN	—	—	Naval	—	—	—
Donegal	HDG	240	300, 400, 600	Limited	Permanent while crossing Heysham to Belfast	0.05	0.50
*Donegal	RDP	—	—	Naval	—	—	—
*Doris	RDT	—	—	Naval	—	—	—
Dover Castle	MQM	450	300, 600	General	Permanent	0.40	—
*Drake	RFC	—	—	Naval	—	—	—
*Dreadnought	RFH	—	—	Naval	—	—	—
Dresden	PQD	280	300, 450, 600	Limited	Permanent while crossing Harwich to Hook of Holland	0.10	1.00
*Duke of Edinburgh	RFT	—	—	Naval	—	—	—
*Duncan	RFV	—	—	Naval	—	—	—
Dunluce Castle	MQO	450	300, 600	General	Permanent	0.40	—
Dunvegan Castle	MPQ	450	300, 600	General	Permanent	0.40	—
Durham Castle	MQN	450	300, 600	General	Permanent	0.40	—
*Eclipse	RHJ	—	—	Naval	—	—	—
*Edgar	RHM	—	—	Naval	—	—	—
Edinburgh Castle	MQE	450	300, 600	General	Permanent	0.40	—

Egypt	MMG	450	300, 600	General	Permanent	0.40	—
Electra	MEE	250	300, 600	Private	—	0.40	—
Elmina	MZI	450	300, 600	General	Permanent	0.40	—
Empress	SEE	150	150, 300, 600	General	Permanent	0.15	1.50
Empress of Britain	MPB	270	300, 600	General	Permanent	0.40	—
Empress of India	MPI	450	300, 600	General	Permanent	0.40	—
*Empress of India	RJC	—	—	Naval	—	—	—
Empress of Ireland	MPL	270	300, 600	General	Permanent	0.40	—
Empress of Japan	MPJ	450	300, 600	General	Permanent	0.40	—
Empress Queen	MEQ	120	300	Limited	Permanent while crossing Liverpool to Douglas	0.05	0.50
*Enchantress	RJH	—	—	Naval	—	—	—
*Encounter	RJK	—	—	Naval	—	—	—
*Endymion	RJM	—	—	Naval	—	—	—
Eskimo	USK	250	300, 600	General	Permanent	0.15	0.90
*Espiegle	RJW	—	—	Naval	—	—	—
*Essex	RKB	—	—	Naval	—	—	—
*Europa	RKH	—	—	Naval	—	—	—
*Euryalus	RKJ	—	—	Naval	—	—	—
*Exmouth	RKN	—	—	Naval	—	—	—
Falaba	MZK	450	300, 600	General	Permanent	0.40	—
*Falmouth	RKW	—	—	Naval	—	—	—
*Flora	RMC	—	—	Naval	—	—	—
Florizel	MZL	450	300, 600	General	Permanent	0.40	—
*Foresight	RMK	—	—	Naval	—	—	—
*Formidable	RMN	—	—	Naval	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
*Forte	RMQ	—	—	Naval	—	—	—
*Forth	RMS	—	—	Naval	—	—	—
*Forward	RMV	—	—	Naval	—	—	—
*Fox	RNB	—	—	Naval	—	—	—
Francis	MDG	450	300, 600	General	Permanent	0.40	—
Franconia	MEA	450	300, 600	General	Permanent	0.40	—
*Furious	RNT	—	—	Naval	—	—	—
Furnessia	MFI	450	300, 600	General	Permanent	0.40	—
Gaika	MQU	450	300, 600	General	Permanent	0.40	—
Galeka	MQR	450	300, 600	General	Permanent	0.40	—
Galician	MQT	450	300, 600	General	Permanent	0.40	—
Galileo	UGO	450	300, 600	General	Permanent	0.40	—
Garth Castle	MQP	450	300, 600	General	Permanent	0.40	—
Gascon	MQV	450	300, 600	General	Permanent	0.40	—
German	MQS	450	300, 600	General	Permanent	0.40	—
*Gibraltar	RPM	—	—	Naval	—	—	—
*Glasgow	RPS	—	—	Naval	—	—	—
*Glory	RPT	—	—	Naval	—	—	—
*Gloucester	RPV	—	—	Naval	—	—	—
Gloucestershire	MYG	450	300, 600	General	Permanent	0.40	—
*Goliath	RQC	—	—	Naval	—	—	—
*Good Hope	RQH	—	—	Naval	—	—	—
Goorkha	MQW	450	300, 600	General	Permanent	0.40	—
Goth	MQY	450	300, 600	General	Permanent	0.40	—
*Grafton	RQS						



The Operator's Room on a liner, showing the Receiving Apparatus for a 5-kw. Station.

[To face page 252

Grampian	MRN	270	300, 600	General	Permanent	0.40	—
Grantully Castle	MQQ	450	300, 600	General	Permanent	0.40	—
Guelph	MQD	450	300, 600	General	Permanent	0.40	—
*Halcyon	RSP	—	—	Naval	—	—	—
*Hampshire	RSV	—	—	Naval	—	—	—
*Hannibal	RTC	—	—	Naval	—	—	—
Haverford	MJH	270	300, 600	General	Permanent	0.40	—
*Hawke	RTW	—	—	Naval	—	—	—
*Hazard	RVB	—	—	Naval	—	—	—
*Hebe	RVH	—	—	Naval	—	—	—
*Hecla	RVJ	—	—	Naval	—	—	—
*Hercules	RVQ	—	—	Naval	—	—	—
*Hermes	RVT	—	—	Naval	—	—	—
*Hermione	RVW	—	—	Naval	—	—	—
Hesperian	MSN	270	300, 600	General	Permanent	0.40	—
*Hibernia	RWD	—	—	Naval	—	—	—
*Highflyer	RWF	—	—	Naval	—	—	—
Highland Brae	UHB	400	300, 600	General	Permanent	0.40	—
Highland Corrie	UHC	400	300, 600	General	Permanent	0.40	—
Highland Glen	UHG	400	300, 600	General	Permanent	0.40	—
Highland Laddie	UHL	400	300, 600	General	Permanent	0.40	—
Highland Pride	UHP	400	300, 600	General	Permanent	0.40	—
Highland Rover	UHR	400	300, 600	General	Permanent	0.40	—
Highland Scot	UHS	400	300, 600	General	Permanent	0.40	—
Hilary	MDP	450	300, 600	General	Permanent	0.40	—
Himalaya	MNY	450	300, 600	General	Permanent	0.40	—
*Hindustan	RWK	—	—	Naval	—	—	—
*Hogue	RWN	—	—	Naval	—	—	—
Huayna	MDV	450	300, 600	General	Permanent	0.40	—
Hubert	MDH	450	300, 600	General	Permanent	0.40	—
*Hussar	SBJ	—	—	Naval	—	—	—

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Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
*Hyacinth	SBM	—	—	Naval	—	—	—
Idaho	UIO	450	300, 600	General	Permanent	0.40	—
*Illustrious	SBT	—	—	Naval	—	—	—
*Implacable	SCF	—	—	Naval	—	—	—
Inanda	MID	270	300, 600	General	Permanent	0.40	—
*Indefatigable	SCK	—	—	Naval	—	—	—
India	MMY	450	300, 600	General	Permanent	0.40	—
*Indomitable	SCM	—	—	Naval	—	—	—
*Inflexible	SCV	—	—	Naval	—	—	—
Inkosi	MIK	270	300, 600	General	Permanent	0.40	—
*Intrepid	SDC	—	—	Naval	—	—	—
Invicta	SEI	150	150, 300, 600	General	Permanent	0.15	1.50
*Invincible	SDH	—	—	Naval	—	—	—
Ionian	MIN	270	300, 600	General	Permanent	0.40	—
*Ionic	MWI	450	300, 600	General	Permanent	0.40	—
Iphigenia	SDJ	—	—	Naval	—	—	—
Iroquois	MEI	160	300, 600	Private	—	—	—
*Irresistible	SDL	—	—	Naval	—	—	—
*Isis	SDN	—	—	Naval	—	—	—
Italia	MAR	450	300, 600	General	Permanent	0.40	—
Ivernia	MIA	450	300, 600	General	Permanent	0.40	—
John Pender	MEF	250	300, 600	Private	—	0.40	—
*Juno	SFQ	—	—	Naval	—	—	—
*Jupiter	SFT	—	—	Naval	—	—	—

Karina	MZJ	450	300, 600	General	Permanent	0.40	—
Kenilworth Castle	MQF	450	300, 600	General	Permanent	0.40	—
*Kent	SHL	—	—	Naval	—	—	—
Kildonan Castle	MQK	450	300, 600	General	Permanent	0.40	—
Kinfauns Castle	MQL	450	300, 600	General	Permanent	0.40	—
*King Alfred	SHT	—	—	Naval	—	—	—
*King Edward VII	SHV	—	—	Naval	—	—	—
Lake Champlain	MLN	270	300, 600	General	Permanent	0.40	—
Lake Erie	MLE	270	300, 600	General	Permanent	0.40	—
Lake Manitoba	MLM	270	300, 600	General	Permanent	0.40	—
Lake Michigan	MLH	270	300, 600	General	Permanent	0.40	—
*Lancaster	SJP	—	—	Naval	—	—	—
Lanfranc	MDS	450	300, 600	General	Permanent	0.40	—
Laurentic	MIC	450	300, 600	General	Permanent	0.40	—
*Leander	SKF	—	—	Naval	—	—	—
*Leda	SKH	—	—	Naval	—	—	—
Leicestershire	MYL	450	300, 600	General	Permanent	0.40	—
*Leviathan	SKP	—	—	Naval	—	—	—
*Liverpool	SLK	—	—	Naval	—	—	—
*London	SLR	—	—	Naval	—	—	—
Londonderry	HSM	240	300, 400. 600	Limited	Permanent during crossing, Heysham to Belfast	0.05	0.50
*Lord Nelson	SLT	—	—	Naval	—	—	—
Lusitania	MFA	450	110, 300, 600	General	Permanent	0.40	—
Macedonia	MML	450	300, 600	General	Permanent	0.40	—
Mackay-Bennett	MMB	450	300, 600	Private	—	—	—
Magdalena	UND	300	300, 600	General	Permanent	0.40	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
Magnet	MEH	250	300, 600	Private	—	0.40	—
*Magnificent	SMN	—	—	Naval	—	—	—
Majestic	MMC	270	300, 600	General	Permanent	0.40	—
*Majestic	SMV	—	—	Naval	—	—	—
Malwa	MMD	450	300, 600	General	Permanent	0.40	—
Manco	MDW	450	300, 600	General	Permanent	0.40	—
Manitou	MNM	300	300, 600	General	Permanent	0.40	—
Mantua	MME	450	300, 600	General	Permanent	0.40 [9]	— [9]
Marmora	MMR	450	300, 600	General	Permanent	0.40	—
Marquette	MNQ	300	300, 600	General	Permanent	0.40	—
*Mars	SNK	—	—	Naval	—	—	—
Mauretania	MGA	450	110, 300, 600	General	Permanent	0.40	—
*Medea	SNQ	—	—	Naval	—	—	—
Medic	MKK	450	300, 600	General	Permanent	0.40	—
Megantic	MZC	450	300, 600	General	Permanent	0.40	—
*Melpomene	SNV	—	—	Naval	—	—	—
Menominee	MNE	300	300, 600	General	Permanent	0.40	—
Merion	MJM	270	300, 600	General	Permanent	0.40	—
Mersey	MWJ	240	300, 600	General	Permanent	0.40	—
Mesaba	MMV	300	300, 600	General	Permanent	0.40	—
Milwaukee	MLF	270	300, 600	General	Permanent	0.40	—
*Minerva	SPN	—	—	Naval	—	—	—
Minia	ANM	160	300	Private	Permanent	—	—
Minneapolis	MMN	160	300, 600	General	Permanent	0.40	—

Minnehaha	MMA	160	300, 600	General	Permanent	0.40	—
Minnetonka	MMK	160	300, 600	General	Permanent	0.40	—
Minnewaska	MMW	400	300, 600	General	Permanent	0.40	—
*Minotaur	SPQ	—	—	Naval	—	—	—
Moldavia	MMH	450	300, 600	General	Permanent	0.40	—
Mongolia	MMJ	450	300, 600	General	Permanent	0.40	—
Mongolian	MON	270	300, 600	General	Permanent	0.40	—
Monmouth	MGV	270	300, 600	General	Permanent	0.40	—
*Monmouth	SQC	—	—	Naval	—	—	—
Montcalm	MLZ	270	300, 600	General	Permanent	0.40	—
Montezuma	MLK	270	300, 600	General	Permanent	0.40	—
Montfort	MLW	270	300, 600	General	Permanent	0.40	—
Montreal	MLI	270	300, 600	General	Permanent	0.40	—
Montrose	MLJ	270	300, 600	General	Permanent	0.40	—
Mooltan	MMM	450	300, 600	General	Permanent	0.40	—
Morea	MMF	450	300, 600	General	Permanent	0.40	—
Mount Royal	MLO	270	300, 600	General	Permanent	0.40	—
Mount Temple	MLQ	270	300, 600	General	Permanent	0.40	—
Munich	PQM	280	300, 450, 600 [7]	Limited	Permanent during crossing, Hook to Harwich	0.10	1.00
*Naiad	SQR	—	—	Naval	—	—	—
Narragansett	MEC	160	300, 600	Private	—	—	—
*Natal	SQT	—	—	Naval	—	—	—
Navahoe	MEN	160	300, 600	Private	—	—	—
*Neptune	SRH	—	—	Naval	—	—	—
*Newcastle	SRP	—	—	Naval	—	—	—
*Niger	SRW	—	—	Naval	—	—	—
Norman	MOM	450	300, 600	General	Permanent	0.40	—
Norseman	MEG	250	300, 600	Private	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge.	
						Per Word.	Minimum Charge.
						Francs.	Francs.
GREAT BRITAIN *contd.*							
Numidian	MNN	270	300, 600	General	Permanent	0.40	—
*Ocean	SVB	—	—	Naval	—	—	—
Oceanic	MOC	270	300, 600	General	Permanent	0.40	—
*Odin	SVF	—	—	Naval	—	—	—
Olympic	—	—	—	General	Permanent	0.40	—
Omrah	MOK	450	300, 600	General	Permanent	0.40	—
Onward	SEO	150	150, 300, 600	General	Permanent	0.15 [8]	1.50 [8]
Oravia	MJB	450	300, 600	General	Permanent	0.40	—
Orcoma	MJF	450	300, 600	General	Permanent	0.40	—
Oriana	MJJ	450	300, 600	General	Permanent	0.40	—
Orissa	MJE	450	300, 600	General	Permanent	0.40	—
Orita	MJG	450	300, 600	General	Permanent	0.40	—
Oronsa	MJI	450	300, 600	General	Permanent	0.40	—
Orontes	MOZ	450	300, 600	General	Permanent	0.40	—
Oropesa	MJA	450	300, 600	General	Permanent	0.40	—
Orsova	MOF	450	300, 600	General	Permanent	0.40	—
Ortega	MJK	450	300, 600	General	Permanent	0.40	—
Oruba	UNU	300	300, 600	General	Permanent	0.40	—
Orvieto	MOJ	450	300, 600	General	Permanent	0.40	—
Oslo	MWO	320	300, 600	General	Permanent	0.15	0.90
Osterley	MOY	450	300, 600	General	Permanent	0.40	—
Otranto	MOD	450	300, 600	General	Permanent	0.40	—
Otway	MOH	450	300, 600	General	Permanent	0.40	—
*Pandora	SWP	—	—	Naval	—	—	—

Pannonia	MNA	270	300, 600	General	Permanent	0.40	—
Parisian	MZN	270	300, 600	General	Permanent	0.40	—
*Pathfinder	SWV	—	—	Naval	—	—	—
Patrol	MEM	250	300, 600	Private	—	0.40	—
*Patrol	TBC	—	—	Naval	—	—	—
*Pegasus	TBK	—	—	Naval	—	—	—
*Pelorus	TBM	—	—	Naval	—	—	—
Perseus	TCB	—	—	Naval	—	—	—
Persia	MMQ	450	300, 600	General	Permanent	0.40	—
Persic	MQC	450	300, 600	General	Permanent	0.40	—
Perugia	MAW	450	300, 600	General	Permanent	0.40	—
*Philomel	TCN	—	—	Naval	—	—	—
*Pioneer	TDH	—	—	Naval	—	—	—
*Powerful	TDS	—	—	Naval	—	—	—
Pretorian	MFN	270	300, 600	General	Permanent	0.40	—
Prince Arthur	MYU	450	300, 600	General	Permanent	0.40	—
Prince George	MYV	450	300, 600	General	Permanent	0.40	—
Prince George	UPG	160	300, 600	General	8 a.m. to 12 midnight	—[10]	—[10]
*Prince George	TFB	—	—	Naval	—	—	—
*Prince of Wales	TFD	—	—	Naval	—	—	—
Prince Rupert	UPR	160	300	General	8 a.m. to 12 midnight	—[10]	—[10]
*Prometheus	TFN	—	—	Naval	—	—	—
*Proserpine	TFQ	—	—	Naval	—	—	—
*Psyche	THB	—	—	Naval	—	—	—
*Pyramus	THF	—	—	Naval	—	—	—
Queen (The)	SEQ	150	150, 300, 600	General	Permanent	0.15 [8]	1.50 [8]
*Queen	TKV	—	—	Naval	—	—	—
Recorder	MEJ	250	300, 600	Private	—	0.40	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Services.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
*Revenge	TLN	—	—	Naval	—	—	—
Rosalind	MZR	450	300, 600	General	Permanent	0.40	—
*Rosario	TMN	—	—	Naval	—	—	—
Roseric	UWA	250	300, 600	General	Permanent	—	—
*Roxburgh	TMW	—	—	Naval	—	—	—
*Royal Arthur	TNC	—	—	Naval	—	—	—
Royal Edward	MER	450	300, 600	General	Permanent	0.40	—
Royal George	MGR	450	300, 600	General	Permanent	0.40	—
*Royal Oak	TNH	—	—	Naval	—	—	—
Runic	MWC	450	300, 600	General	Permanent	0.40	—
*Russell	TNM	—	—	Naval	—	—	—
*Sapphire	TPK	—	—	Naval	—	—	—
*Sappho	TPL	—	—	Naval	—	—	—
Sardinian	MDN	270	300, 600	General	Permanent	0.40	—
Saturnia	MBF	450	300, 600	General	Permanent	0.40	—
Saxon	MQI	450	300, 600	General	Permanent	0.40	—
Saxonia	MSA	450	300, 600	General	Permanent	0.40	—
Scotian	MJN	450	300, 600	General	Permanent	0.40	—
*Scylla	TQC	—	—	Naval	—	—	—
Seal	MDZ	450	300, 600	General	Permanent	0.40	—
Sentinel	MFB	250	300, 600	Private	—	0.40	—
*Sentinel	TRB	—	—	Naval	—	—	—
*Shannon	TRH	—	—	Naval	—	—	—
*Sharpshooter	TRK	—	—	Naval	—	—	—
Sherard Osborn	MFK	250	300, 600	Private	—	0.40	—

Sicilian	MUN	270	300, 600	General	Permanent	0.40	—
*Sirius	TRV	—	—	Naval	—	—	—
*Skipjack	TSB	—	—	Naval	—	—	—
*Skirmisher	TSC	—	—	Naval	—	—	—
*Spanker	TSL	—	—	Naval	—	—	—
*Spartiate	TSQ	—	—	Naval	—	—	—
*Sphinx	TVF	—	—	Naval	—	—	—
Suevic	MJC	450	300, 600	General	Permanent	0.40	—
*Suffolk	TWQ	—	—	Naval	—	—	—
*Superb	VBC	—	—	Naval	—	—	—
*Surprise	VBH	—	—	Naval	—	—	—
*Sutlej	VBK	—	—	Naval	—	—	—
*Swiftsure	VBP	—	—	Naval	—	—	—
*S. George	TNS	—	—	Naval	—	—	—
S. Petersburg	PQP	200	300, 450, 600	Limited	Permanent while crossing Harwich to Antwerp	0.10	1.00
*S. Vincent	TNV	—	—	Naval	—	—	—
Tagus	UNS	300	300, 600	General	Permanent	0.40	—
Tainui	MWF	450	300, 600	General	Permanent	0.40	—
*Talbot	VCL	—	—	Naval	—	—	—
Tamarac	MEB	160	300, 600	Private	—	—	—
Telconia	MCJ	120	300, 600	Private	Permanent	—	—
*Temeraire	VCW	—	—	Naval	—	—	—
*Terpsichore	VDC	—	—	Naval	—	—	—
Terrible	VDF	—	—	Naval	—	—	—
Teutonic	MTC	270	300, 600	General	Permanent	0.40	—
Thames	UNM	300	300, 600	General	Permanent	0.40	—
*Thames	VDM	—	—	Naval	—	—	—
*Theseus	VDP	—	—	Naval	—	—	—

Ship Stations—*Continued*

Name	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
GREAT BRITAIN *contd.*						Francs.	Francs.
*Topaze	VFQ	—	—	Naval	—	—	—
Torbay Scout (late Flying Swift)	UFS	80.	300	Private	Permanent	—	—
*Torch	VFS	—	—	Naval	—	—	—
Trent	UNR	300	300, 600	General	Permanent	0.40	—
Tritonia	MBJ	450	300, 600	General	Permanent	0.40	—
*Triumph	VHK	—	—	Naval	—	—	—
Tunisian	MTN	270	300, 600	General	Permanent	0.40	—
Ultonia	MTA	270	300, 600	General	Permanent	0.40	—
Valhalla	MVH	360	300, 600	General	Permanent while crossing	—	—
*Vanguard	VJM	—	—	Naval	—	—	—
Vasari	UVR	450	300, 600	General	Permanent	0.40	—
*Venerable	VJR	—	—	Naval	—	—	—
*Vengeance	VJS	—	—	Naval	—	—	—
*Venus	VJT	—	—	Naval	—	—	—
Verdi	UVD	450	300, 600	General	Permanent	0.40	—
Victoria	SEV	150	150, 300, 600	General	Permanent	0.15	1.50
*Victoria and Albert	VKH	—	—	Naval	—	—	—
Victorian	MVN	270	300, 600	General	Permanent	0.40	—
*Victorious	VKJ	—	—	Naval	—	—	—
Vienna	PQV	280	300, 450, 600	Limited	Permanent while crossing Harwich to Hook	0.10	1.00

Viking	MVQ	120	300	Limited	Permanent while crossing Liverpool to Douglas	0.05	0.50
Viking (The)	MVK	450	300, 600	General	Permanent	0.40	—
*Vindictive	VKR	—	—	Naval	—	—	—
Virginian	MGN	270	300, 600	General	Permanent	0.40	—
Voltaire	UVL	450	300, 600	General	Permanent	0.40	—
*Vulcan	VLP	—	—	Naval	—	—	—
Walmer Castle	MQH	450	300, 600	General	Permanent	0.40	—
*Warrior	VLW	—	—	Naval	—	—	—
*Weymouth	VML	—	—	Naval	—	—	—
Winifredian	MFL	450	300, 600	General	Permanent	0.40	—
*Yarmouth	VNT	—	—	Naval	—	—	—
Zeeland	MZD	160	300, 600	General	Permanent	0.40	—
ITALY							
*Agordat	—	—	—	—	—	—	—
*Alpino	—	—	—	—	—	—	—
*Amalfi	—	—	—	—	—	—	—
America	MVS	800	300, 600	General	Permanent	0.40	—
*Americo Vespucci	—	—	—	—	—	—	—
*Ammiraglio Saint Bon	—	—	—	—	—	—	—
Ancona	MOA	800	300, 600	General	Permanent	0.40	—
*Andrea Doria	—	—	—	—	—	—	—
*Aquilone	—	—	—	—	—	—	—
*Aretusa	—	—	—	—	—	—	—
*Artigliere	—	—	—	—	—	—	—
*Benedetto Brin	—	—	—	—	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum. Charge
						Francs.	Francs.
ITALY—*continued*							
*Bersagliere	—	—	—	—	—	—	—
Bologna	MOB	500	300, 600	General	Permanent	0.40	—
*Borea	—	—	—	—	—	—	—
*Bronte	—	—	—	—	—	—	—
*Calabria	—	—	—	—	—	—	—
*Carabiniere	—	—	—	—	—	—	—
*Carlo Alberto	—	—	—	—	—	—	—
Citta di Milano	MVM	500	300, 600	General	Permanent	0.40	—
Citta di Torino	MVP	500	300, 600	General	Permanent	0.40	—
*Coatit	—	—	—	—	—	—	—
*Corazziere	—	—	—	—	—	—	—
Cordova	MAG	500	300, 600	General	Permanent	0.40	—
*Dandolo	—	—	—	—	—	—	—
*Dardo	—	—	—	—	—	—	—
Duca Abruzzi	MAD	800	300, 600	General	Permanent	0.40	—
Duca d'Aosta	MAO	800	300, 600	General	Permanent	0.40	—
Duca di Genova	MAE	800	300, 600	General	Permanent	0.40	—
*Elba	—	—	—	—	—	—	—
*Emanuele Filiberto	—	—	—	—	—	—	—
*Espero	—	—	—	—	—	—	—
*Etna	—	—	—	—	—	—	—
*Etruria	—	—	—	—	—	—	—
*Euro	—	—	—	—	—	—	—
Europa	MVE	800	300, 600	General	Permanent	0.40	—
*Flavio Gioja	—	—	—	—	—	—	—

*Francesco Ferruccio	—	—	—	—	—	—	—
*Freccia . . .	—	—	—	—	—	—	—
*Fuciliere . .	—	—	—	—	—	—	—
*Fulmine . .	—	—	—	—	—	—	—
*Garibaldino . .	—	—	—	—	—	—	—
*Giovanni Bausan .	—	—	—	—	—	—	—
*Guiseppe Garibaldi .	—	—	—	—	—	—	—
*Goito . . .	—	—	—	—	—	—	—
*Governolo . .	—	—	—	—	—	—	—
*Granatiere . .	—	—	—	—	—	—	—
Indiana . . .	MAK	500 .	300, 600	General . .	Permanent .	0.40	—
*Iride . . .	—	—	—	—	—	—	—
Italia . . .	MVC .	500 .	300, 600	General . .	Permanent .	0.40	—
*Italia . . .	—	—	—	—	—	—	—
*Lampo . . .	—	—	—	—	—	—	—
*Lanciere . .	—	—	—	—	—	—	—
Lazio . . .	MRZ .	500 .	300, 600	General . .	Permanent .	0.40	—
*Lepanto . .	—	—	—	—	—	—	—
*Liguria . . .	—	—	—	—	—	—	—
*Lombardia . .	—	—	—	—	—	—	—
Luisiana . .	MAM	500 .	300, 600	General . .	Permanent .	0.40	—
*Marco Antonio Colonna	—	—	—	—	—	—	—
*Marco Polo . .	—	—	—	—	—	—	—
Mendoza . .	MAF .	500 .	300, 600	General . .	Permanent .	0.40	—
Minas . . .	MOP .	300 .	300, 600	General . .	Permanent .	0.40	—
*Minerva . .	—	—	—	—	—	—	—
*Napoli . . .	—	—	—	—	—	—	—
*Nembo . . .	—	—	—	—	—	—	—
*Ostro . . .	—	—	—	—	—	—	—
*Partenope . .	—	—	—	—	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
ITALY—*continued*							
*Piemonte	—	—	—	—	—	—	—
*Pisa	—	—	—	—	—	—	—
*Pontiere	—	—	—	—	—	—	—
Principe di Piemonte	MRP	500	300, 600	General	Permanent	0.40	—
Principe di Udine	MRV	800	300, 600	General	Permanent	0.40	—
Principessa Mafalda	MIM	1,000	300, 600	General	Permanent	0.40	—
Principe Umberto	MRU	800	300, 600	General	Permanent	0.40	—
*Puglia	—	—	—	—	—	—	—
Ravenna	MOR	500	300, 600	General	Permanent	0.40	—
Re d'Italia	MRI	300	300, 600	General	Permanent	0.40	—
Regina d'Italia	MRG	300	300, 600	General	Permanent	0.40	—
Regina Elena	MRE	800	300, 600	General	Permanent	0.40	—
*Regina Elena	—	—	—	—	—	—	—
*Regina Margherita	—	—	—	—	—	—	—
Re Umberto	MUP	300	300, 600	General	Permanent	0.40	—
*Re Umberto	—	—	—	—	—	—	—
Re Vittorio	MRO	800	300, 600	General	Permanent	0.40	—
*Roma	—	—	—	—	—	—	—
Sannio	MRL	500	300, 600	General	Permanent	0.40	—
*Sardegna	—	—	—	—	—	—	—
Savoia	MVF	500	300, 600	General	Permanent	0.40	—

*Sicilia	—	—	—	—	—	—	—
Siena	MOE	500	300, 600	General	Permanent	0.40	—
*Staffetta	—	—	—	—	—	—	—
*Sterope	—	—	—	—	—	—	—
*Strale	—	—	—	—	—	—	—
S. Giorgio	MSH	500	300, 600	General	Permanent	—	—
*S. Giorgio	—	—	—	—	—	—	—
S. Giovanni	MSI	500	300, 600	General	Permanent	0.40	—
*S. Marco	—	—	—	—	—	—	—
Taormina	MOT	800	300, 600	General	Permanent	0.40	—
Tomaso di Savoia	MRS	500	300, 600	General	Permanent	0.40	—
Toscana	MOS	500	300, 600	General	Permanent	0.40	—
*Trinacria	—	—	—	—	—	—	—
*Tripoli	—	—	—	—	—	—	—
*Turbine	—	—	—	—	—	—	—
Umbria	MAU	500	300, 600	General	Permanent	0.40	—
*Urania	—	—	—	—	—	—	—
*Varese	—	—	—	—	—	—	—
Verona	MOV	800	300, 600	General	Permanent	0.40	—
*Vettor Pisani	—	—	—	—	—	—	—
*Vittorio Emanuele	—	—	—	—	—	—	—
*Volta	—	—	—	—	—	—	—
*Volturno	—	—	—	—	—	—	—
*Vulcano	—	—	—	—	—	—	—
*Zeffiro	—	—	—	—	—	—	—
JAPAN							
America Maru	TAC	1,200–2,000	300	General	Permanent	0.40	—
Awa Maru	YAW	1,200–2,000	300	General	Permanent	0.40	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
JAPAN—*continued.*							
Buyo Maru	TBY	1,200–2,000	300	General	Permanent	0.40	—
Chiyo Maru	TCY	1,200–2,000	300	General	Permanent	0.40	—
Hongkong Maru	THN	1,200–2,000	300	General	Permanent	0.40	—
Inaba Maru	YIB	1,200–2,000	300	General	Permanent	0.40	—
Kasado Maru	SKT	1,200–2,000	300	General	Permanent	0.40	—
Kayo Maru	OKY	1,200–2,000	300	General	Permanent	0.40	—
Nippon Maru	TNP	1,200–2,000	300	General	Permanent	0.40	—
Sado Maru	YSD	1,200–2,000	300	General	Permanent	0.40	—
Shinano Maru	YSN	1,200–2,000	300	General	Permanent	0.40	—
Taisei Maru	MTS	1,200–2,000	300	General	Permanent	0.40	—
Tamba Maru	YTB	1,200–2,000	300	General	Permanent	0.40	—
Tenyo Maru	TTY	1,200–2,000	300	General	Permanent	0.40	—

MONACO							
*Hirondelle . .	CQA .	700 .	300, 600	Private . .	8 a.m. to 12 midnight	0.30	3.00
NETHERLANDS							
Batavier II. . .	BBS .	350 .	300, 450, 600	Limited [11] .	While crossing .	0.05 [13]	0.50 [13]
Batavier III. . .	BBT .	350 .	300, 450, 600	Limited [11] .	While crossing .	0.05 [13]	0.50 [13]
Batavier IV. . .	BBF .	350 .	300, 450, 600	Limited [11] .	While crossing .	0.05 [13]	0.50 [13]
Batavier V. . .	BBV .	350 .	300, 450, 600	Limited [11] .	While crossing .	0.05 [13]	0.50 [13]
*De Ruyter . .	DRT .	300 .	300, 600	Special [12] .	—	—	—
*De Zeven Provincien	ZPN .	500 .	300, 600	Special [12] .	—	—	—
*Evertsen . .	EVN .	200 .	300, 600	Special [12] .	—	—	—
*Fret . . .	FRE .	150 .	300, 600	Special [12] .	—	—	—
*Friesland . .	FRL .	200 .	300, 600	Special [12] .	—	—	—
Frisia . .	MKF	250 .	300, 600	General . .	Permanent .	0.40	4.00
*Gelderland . .	GDL .	200 .	300, 600	Special [12] .	—	—	—
Goentoer . .	MRQ	300 .	300, 450, 600	General . .	Permanent .	0.40	4.00
Grotius . . .	MNG	300 .	300, 450, 600	General . .	Permanent .	0.40	4.00
*Hertog Hendrik .	HDK.	300 .	300, 600	Special [12] .	—	—	—
*Holland. . .	HLD .	300 .	300, 600	Special [12] .	—	—	—
Hollandia . .	MKH.	250 .	300, 600	General . .	Permanent .	0.40	4.00
*Jacob van Heemskerck .	HMK.	200 .	300, 600	Special [14] .	—	—	—
Kawi . . .	MRK.	300 .	300, 450, 600	General . .	Permanent .	0.40	4.00
Koningin Regentes	SZR .	250 .	300, 500 [15]	Limited [16] .	11 a.m. to 6 p.m.	— [17]	— [17]

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
NETHERLANDS *contd.*						Francs.	Francs.
*Koningin Regentes	KRG	300	300, 600	Special [14]	—	—	—
Koningin Wilhelmina	SZW	250	300, 500 [15]	Limited [16]	11 a.m. to 6 p.m.	—[17]	—[17]
Koning Willem	MNW	300	300, 450, 600	General	Permanent	0.40	4.00
Koning Willem III	MNT	300	300, 450, 600	General	Permanent	0.40	4.00
*Kortenear	KTR	200	300, 600	Special [14]	—	—	—
*Maarten Harpertz Tromp	TRP	500	300, 600	Special [14]	—	—	—
Mecklenberg	SZM	250	300, 500 [15]	Limited [16]	10 a.m. to 5 p.m.	—[17]	—[17]
Nieuw Amsterdam	MHB	300	120, 300, 600	General	Permanent	0.40	4.00
Noordam	MHA	300	120, 300, 600	General	Permanent	0.40	4.00
*Noordbrabant	NBR	300	300, 600	Special [14]	—	—	—
Ophir	MRJ	300	300, 450, 600	General	Permanent	0.40	4.00
Oranje	MNO	300	300, 450, 600	General	Permanent	0.40	4.00
Oranje Nassau	SZU	250	300, 500 [15]	Limited [16]	10 a.m. to 5. p.m.	—[17]	17
*Piet Hein	PHN	200	300, 600	Special [14]	—	—	—
Potsdam	MHM	300	120, 300,	General	Permanent	0.40	4.00

Prinses Juliana	MNP	300	300, 450, 600	General	Permanent	0.40	4.00
Prinses Juliana	SZA	250	300, 500, [15]	Limited [16]	10 a.m. to 5 p.m.	—[17]	—[17]
Prins Hendrik	SZH	250	300,500 [15]	Limited [16]	11 a.m. to 6 p.m.	—[17]	—[17]
Rembrandt	MNR	300	300, 450, 600	General	Permanent	0.40	4.00
Rindjani	MRR	300	300, 450, 600	General	Permanent	0.40	4.00
Rotterdam	MHR	100, 300, 400	120, 300, 600	General	Permanent	0.40	4.00
Ryndam	MHY	300	120, 300, 600	General	Permanent	0.40	4.00
Sindoro	MRD	300	300, 450, 600	General	Permanent	0.40	4.00
Tabanan	MRT	300	300, 450, 600	General	Permanent	0.40	4.00
Tambora	MRY	300	300, 450, 600	General	Permanent	0.40	4.00
*Utrecht	UTR	300	300, 600	Special	—	—	—
Vondel	MNV	300	300, 450, 600	General	Permanent	0.40	4.00
Wilis	MRW	300	300, 450, 600	General	Permanent	0.40	4.00
*Wolf	WLF	150	300, 600	Special	—	—	—
*Zeehond	ZOD	200	300, 600	Special	—	—	—
*Zeeland	ZLD	300	300, 600	Special	—	—	—
Zeelandia	MKZ	250	300, 450, 600	General	Permanent	0.40	4.00
NORWAY							
*Draug	DRG	—	—	Naval	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
NORWAY—*continued.*						Francs.	Francs.
*Eidsvold	EDS	—	—	Naval	—	—	—
*Frithjof.	FRT	—	—	Naval	—	—	—
*Harald Haarfagre	HHR	—	—	Naval	—	—	—
*Heimdal	HMD	—	—	Naval	—	—	—
Kong Harald	KGH	300	300, 450, 600	General	1 to 3 a.m., 7 to 9 a.m., 1 to 3 p.m., 7 to 9 p.m.	0.20	2.00
*Norge	NRG	—	—	Naval	—	—	—
Noruega	URG	350	300	General	4 a.m. to 8 p.m., 6 p.m. to 6 a.m.	0.40	4.00
*Skarv	SKR	—	—	Naval	—	—	—
Sterling	MOG	300	300, 450, 600	General	Permanent	0.28	2.80
*Teist	TST	—	—	Naval	—	—	—
*Tordenskjold	TRD	—	—	Naval	—	—	—
*Troll	TRL	—	—	Naval	—	—	—
*Tyr	TYR	—	—	Naval	—	—	—
*Valkyrjen	VLK	—	—	Naval	—	—	—
*Viking	VKN	—	—	Naval	—	—	—
PORTUGAL							
*Adamastor	GPE	270	300, 450, 600	Special	Permanent	—	—
Africa	MEV	300	300, 450,	General	Permanent	0.40	4.00

*Almirante Reis	GPA	270	300, 450, 600	Special	Permanent	—	—
Beira	MEY	300	300, 450, 600	General	Permanent	0.40	4.00
Lusitania	MEW	300	300, 450, 600	General	Permanent	0.40	4.00
*S. Gabriel	GPD	270	300, 450, 600	Special	Permanent	—	—
*S. Rafael	GPC	270	300, 450, 600	Special	Permanent	—	—
*Vasco de Gama	GPB	270	300, 450, 600	Special	Permanent	—	—
ROUMANIA							
Dacia	DAC	500	600	Limited [18]	Tu. and Sat., 10 a.m. to 12 midnight; Mon. and Fri., 1 a.m. to 12 midday	—[19]	—[19]
Imparatul Traian	ITR	500	600	Limited [18]	Tu. and Sat., 10 a.m. to 12 midnight; Mon. and Fri., 1 a.m. to 12 midday	—[19]	—[19]
Principesa Maria	PAM	500	600	Limited [18]	Tu. and Sat., 10 a.m. to 12 midnight; Mon. and Fri., 1 a.m. to 12 midday	—[19]	—[19]

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
						Francs.	Francs.
ROUMANIA—*continued.*							
Regele Carol I.	CAR	500	600	Limited [18]	Tu. and Sat., 10 a.m. to 12 midnight; Mon. and Fri., 1 a.m. to 12 midday	—[19]	—[19]
Romania	ROM	500	600	Limited [18]	Tu. and Sat., 10 a.m. to 12 midnight; Mon. and Fri., 1 a.m. to 12 midday	—[19]	—[19]
RUSSIA							
Esthonie	SEA	600–700	300	General	8 to 9 a.m., 3 to 4 p.m., 9 to 10 p.m.	0.40	—
Rossia	SRN	600–700	300	General	8 to 9 a.m., 3 to 4 p.m., 9 to 10 p.m.	0.40	—
SPAIN							
A. Lazaro	BRA	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—

Balmes	MYZ	500	300, 450, 600	General	Permanent	0.30	3.00
Barcelo	BRC	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—
Barcelona	MKS	500	300, 400, 600	General	Permanent	0.30	3.00
Cabanal	BRH	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 to 8.15 p.m.	0.30	—
Cadiz	MCS	500	300, 450, 600	General	Permanent	0.30	3.00
*Carlos V.	CQ	200–252	450, 550	—	—	—	—
Catalina	MIS	500	300, 450, 600	General	Permanent	0.30	3.00
*Cataluna	GTE	400	300, 450, 550	Military	Permanent	—	—
Conde Wilfredo	MYS	500	300, 450, 600	General	Permanent	0.30	3.00
*Giralda	GIE	500	300, 500, 600, 1,000	Special	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge.
SPAIN—*continued*						Francs.	Francs
J. J. Sister	BRD	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—
Luis Vives	BLV	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m., to 12.15 a.m.	0.30	—
Martin Saez	MZS	500	300, 450, 600	General	Permanent	0.30	3.00
Miguel M. Pinillos	MGS	500	300, 450, 600	General	Permanent	0.30	3.00
*Numancia	NUE	120	300, 450	Military	Permanent	—	—
Pio IX.	MXS	500	300, 450, 600	General	Permanent	0.30	3.00
*Princesa de Asturias	PAE	400	300, 350, 450, 550	Military	Permanent	—	—
Valbanera	MSV	500	300, 400,	General	Permanent	0.30	3.00

Vicente Puchol	BRD	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—
Vicente La Roda	BRG	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—
Villarreal	BRE	360	300, 600	General	8 to 8.15 a.m., 10 to 10.15 a.m., 12 to 12.15 p.m., 2 to 2.15 p.m., 4 to 4.15 p.m., 8 p.m. to 12.15 a.m.	0.30	—
SWEDEN							
*Aran	GBP	—	—	Naval	—	—	—
*Claes Horn	GID	—	—	Naval	—	—	—
*Clas Uggla	GIF	—	—	Naval	—	—	—
*Dristigheten	GBN	—	—	Naval	—	—	—
*Edda	GQH	—	—	Naval	—	—	—
*Fylgia	GDB	—	—	Naval	—	—	—
*Gota	GBH	—	—	Naval	—	—	—
*Jacob Bagge	GIC	—	—	Naval	—	—	—

Ship Stations—*Continued*

Name.	Call Signal.	Normal Range in Kilometers.	Wave-length in Meters.	Nature of Service.	Hours of Service.	Coast Charge. Per Word.	Coast Charge. Minimum Charge
SWEDEN—*continued.*						Francs.	Francs.
*Magne	GLC	—	—	Naval	—	—	—
*Manligheten	GBT	—	—	Naval	—	—	—
*Mode	GLB	—	—	Naval	—	—	—
*Niord	GBM	—	—	Naval	—	—	—
*Oden	GBK	—	—	Naval	—	—	—
*Ornen	GIB	—	—	Naval	—	—	—
*Oscar II.	GBV	—	—	Naval	—	—	—
*Psilander	GIH	—	—	Naval	—	—	—
*Ragnar	GLF	—	—	Naval	—	—	—
*Rota	GWI	—	—	Naval	—	—	—
*Sigurd	GLH	—	—	Naval	—	—	—
*Skuld	GWH	—	—	Naval	—	—	—
*Svea	GBF	—	—	Naval	—	—	—
*Tapperheten	GBS	—	—	Naval	—	—	—
*Thor	GBL	—	—	Naval	—	—	—
*Thule	GBI	—	—	Naval	—	—	—
*Vidar	GLI	—	—	Naval	—	—	—
*Wale	GLD 462	—	—	Naval	—	—	—
*Wasa	GBR	—	—	Naval	—	—	—
URUGUAY							
*Uruguay	URU	400	450, 600	Special	—	—	—

Name.	Call Signal.
UNITED STATES	
Acapulco	WWO
Adelaine Smith	WHS
Adeline Smith	KSS
Admiral Dewey	KUV
Admiral Farragut	WAF
Admiral Sampson	WAS
Admiral Schley	KUX
Advance	KMV
A. G. Lindsay	WNO
Aileen	NBG
Alabama	AB
Alabama	KSX
Alameda	WAA
Alamo	KAJ
Algonquin	KVG
Alki	WNK
Aloha	KYH
Alleghany	KQA
Allianca	KMA
Alliance	WRV
America	AM
Ancon	KMS
Antilla	XA
Antilles	KKA
Apache	KVA
Aranmore	CRD
Arapahoe	KVB
Argyle	WTB
Arixoba	HC
Ashtabula	RKB

Name.	Call Signal.
UNITED STATES—*Contd.*	
Astral	KTO
Asuncion	WTX
Atalanta	KYA
Atlas	WTT
Aztec	WWQ
Barge 91	WTU
Barge 93	WTY
Barge 94	KTP
Barge 95	WTZ
Bark Berlin	—
Bayamon	KCZ
Bay State	KRE
Bear	WWD
Beaver	WWB
Belfast	KRD
Berkshire	KQB
Bertha	WBR
Borenquin	KCW
Brazos	KAZ
Breakwater	WBK
Brunswick	KOS
Buckman	WAB
Bunkerhill	KJB
Cabrillo	WBV
Calvin Austin	KRN
Camaquay	XC
Camden	KRC
Camino	WQC
Capt. A. F. Lucas	WTV
Caracas	KDB

Name.	Call Signal.
UNITED STATES—*Contd.*	
Car Ferry No. 1	B1
Car Ferry No. 2	A2
Car Ferry No. 2	B2
Car Ferry No. 3	A3
Car Ferry No. 4	A4
Car Ferry No. 5	A5
Car Ferry No. 15	15
Car Ferry No. 17	17
Car Ferry No. 18	18
Car Ferry No. 19	19
Car Ferry No. 20	20
Carlos	WNC
Carolina	KCB
Carolina	NC
Carolyn	KNF
Cassandra	KYE
Catania	WTJ
Centralia	WSN
Chalmette	KKC
Chehalis	WSH
Cherokee	KVK
Chicago	HO
Chicago	NDI
Chicago	WAC
China	WWA
Christopher Columbus	KC
City of Alpena	CA
City of Atalanta	KFB
City of Augusta	KFJ
City of Baltimore	KRY

Ship Stations—*Continued.*

Name.	Call Signal.	Name.	Call Signal.	Name.	Call Signal.
UNITED STATES—*Contd.*		**UNITED STATES**—*Contd.*		**UNITED STATES**—*Contd.*	
City of Bangor	KRH	Dorothy Bradford	KNA	Harry Luckenbach	KCT
City of Benton	AQ	Dubuque	NEU	Harvard	WRH
City of Buffalo	CF	Eastern States	CS	Havana	KWH
City of Chicago	PQ	Eastland	AD	Hawk	NGW
City of Cleveland	CO	Easton	ES	Helena	HD
City of Columbus	KFA	Edith.	WAE	Herman Frasch	KFH
City of Detroit II.	CD	El Alba	KKL	Hermosa	WBP
City of Detroit III.	CR	El Cid	KKT	Heroine	KUR
City of Erie	CP	El Dia	KKY	Heroine	MUR
City of Everett	KTQ	Elfrida	NFG	Hilonian	WMM
City of Grand Rapids	RQ	El Mundo	KKU	Holland	NQ
City of Mackinac	CW	El Norte	KKN	Honolulan	WKH
City of Macon	KFC	El Occidente	KKK	Howard	KQH
City of Memphis	KFD	El Oriente	KKV	Humboldt	WHX
City of Montgomery	KFY	El Rio	KKZ	Huron	KVH
City of Norfolk	KRZ	El Segundo	ETK	Hyades	WMK
City of Para	WWF	El Siglo	KKS	I. D. Fletcher	KFI
City of Puebla	WGQ	El Sol	KKB	Illinois	—
City of Rockland.	KRI	El Sud	KKQ	Illinois	YN
City of St. Ignace	CG	El Valle	KKW	Indian	KQI
City of St. Louis	KFX	Enterprise	WMN	Indiana	SC
City of Savannah	KFK	Eocene	KTM	Iowa	DC
City of Seattle	WGA	Esperanza	KWZ	Iroquois	KVF
City of So. Haven-Chic.	BX	Essex.	KQE	Iroquois	WBG
City of Sydney	WWG	Essex.	NFJ	Itasca	KQU
City of Topeka	WGY	Evelyn	KNE	J. A. Chanslor	WTK
City of Traverse	WQ	Evichak	WNS	J. A. Hooper	WSJ
Coamo	KCA	Excelsior	[illegible]	[illegible]	[illegible]

Col. E. L. Drake	WTS	F. A. Kilbourne	WRW	Jamestown	KOC
Col. J. M. Schoonmaker	SNR	Falcon	WRK	Jefferson	KOD
Colon	KMX	Fearless	WPF	Jefferson	WAJ
Columbia	KRO	Fearless	WSU	J. M. Guffey	KTF
Columbia	WHC	F. H. Leggett	WSB	Jos. Pulitzer	WPZ
Comal	KAM	Fifield	WRF	Juniata	JA
Comanche	KYC	Finland	KSF	Juniata	KQJ
Comus	KKD	Florence	KYF	Kansas City	WWS
Concho	KAC	Florida	KSY	Karina	KYR
Cordova	WAR	Fort Bragg	WST	Klamath	WSX
Coronado	WSO	Frederick	KQF	Korea	WWK
Corsair	KYC	Frieda	KFF	Kroonland	KSH
Creole	KKR	Georgia	GC	Lampasas	KAP
Cretan	KQC	Georgian	WKG	Larimer	KTA
Cristobal	KMD	General Hubbard	WMT	Lansing	WTC
Crosby	FG	Goliah	WPG	Latouche	WAI
Cuba	KRP	Gopher	NGK	Leelanaw	WNI
Cuba	KUC	Gov. Cobb	KRB	Lenape	KVL
Curacao	WGK	Gov. Dingley	KRV	Lexington	KQL
Curacoa	WGK	Governor	WGR	Lewis Luckenbach	WNH
Curityba	MJU	Gloucester	KQG	Ligonier	KTD
Currier	KNU	Gloucester	NGI	Limit (The)	MY
Dakotan	WKD	Grace Dollar	WSF	Louise	KRL
Delhi	WGD	Grayson	KCV	Lucy Neff	KNQ
Del. Sun	KTW	Grecian	KQR	Lurline	WML
Denver	KAD	Greenwood	WQG	Lysistrata	KYL
Dirigo	WAO	Guantanamo	XG	Machias	NJI
Dolphin	WAU	Gulfoil	KTG	Mackinaw	WHW
Don Juan de Austria	NER	G. W. Elder	WRT	Madison	KOG
Dora	WAH	G. W. Fenwick	WNG	Manchuria	WWE
Dorchester	KQD	Hanalei	WHN	Manitou	MN
Dorothea	NES	Hamilton	KOA	Maracaibo	KDM

Ship Stations—*Continued.*

Name.	Call Signal.	Name.	Call Signal.	Name.	Call Signal.
UNITED STATES—*Contd.*		**UNITED STATES**—*Contd.*		**UNITED STATES**—*Contd.*	
Marblehead	NJO	Perfection	KTN	Siberia	WWU
Mariposa	WHP	Persian	KQX	Sierra	WHJ
Mascotte	KOW	Peru	WWJ	Somerset	KQS
Maverick	WTW	Pettibone	KUP	Sonoma	WHM
M. E. Luckenbach	KDR	Philadelphia	KDA	Speedwell	WQS
Merced Massachusetts	KJM	Philadelphia	KSM	Spokane	WGE
Merrimack	KQM	Pioneer	WPN	Stanley Dollar	WSD
Mexico	KWX	Pleiades	WNP	Starr	WPS
Miami	KOZ	Ponce	KCP	State of Cal.	WGL
Millinocket	KNM	Portland	WNV	Stranger	NTH
Minnesota	MIN	Powhatan	KQY	Sun	KTU
Minnesota	WMI	President	WGP	S. V. Luckenbach	KCS
Minnesotan	WKM	Princess Ann	KOB	Suwanee	KQZ
Missouri	HN	Proteus	KKP	S. Y. Virginia	KYD
Mohawk	KVM	Puritan	SQ	Tasco	KFT
Momus	KKM	Quantico	KQQ	Tatoosh	WPE
Mongolia	WWN	Queen	WGX	Tennessee	KY
Monroe	KOM	Ramsom B. Fuller	KRF	Tionesta	JS
Montauk	KNT	Rayo	KTL	Toledo	KTV
Monterey	KWY	Redondo	WBM	Tuscan	KQT
Morro Castle	KWC	Relay	KVZ	Tyee	WPC
Multnomah	WMA	Relief	KRJ	Tyer, Jr.	WPB
Nacooche	KFP	Rescue	KRP	Umatilla	WGU
Nann Smith	WBO	Reuce	WSR	United States	SA
Nantucket	KQN	Rio Grande	KAG	Vanguard	WNZ
Navajo	WNJ	Riverside	WRM	Ventura	WHL
Nelson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
New Jersey	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

New Orleans	KQV	Roosevelt	SV	Vigilancia	[illegible]
Newport	WWH	Rose City	WWR	Virginia	BC
New York	KNK	Sabine	KAB	Virginia	KSZ
New York	KSN	St. Hellens	WNY	Virginia	KYD
Niagara	KYN	St. Louis	KSL	Vixen	NVS
Noma	KYO	St. Nicholas	WSS	Wallula	WPY
Nome City	WRN	St. Paul	KSO	Warrier	KYW
North Land	KJD	Sandoval	NSD	Washenaw	WTH
Northland	ND	San Jacinto	KAS	Watson	WAW
Northland	WNX	San Jose	WWL	Western States	WS
North Star	KJS	San Juan	KCJ	W. F. Herrin	WTN
Northwestern	WAN	San Juan	WWM	Whittier	WHT
Norwood	WSG	San Marcos	KAK	Wilhelmina	WMO
Nueces	KAH	San Ramon	WNZ	Williamette	WSW
Nushagak	WNE	Santa Anna	WAL	Windber	WND
Nyack	FM	Santa Clara	WRS	Winifred	KTE
Octorara	JR	Santa Cruz	WBD	Wilpen	SNW
Oklahoma	KTB	Santa Cruz	WPA	Wm. B. Davock	WB
Old Colony	KJO	Santa Maria	WTF	Wm. Chatham	WMC
Oleum	WTD	San Mateo	—	Wm. P. Snyder	SND
Olinda	MJT	Santa Rita	WTG	Wm. P. Snyder, jun.	SNG
Oliver J. Olson	WNB	Santiago	XS	Wolverine	NWN
Olivette	KOV	Saratoga	KWS	W. S. Porter	WTM
Oneonta	WPX	Sea Rover	WSV	Wyandotte	KNW
Ontario	KQO	Seguranza	KWG	Yaguez	KCY
Ozark	NOB	Seminole	KVJ	Yale	WRY
Panama	KMH	Senator	WGS	Yantic	NXC
Paraguay	KTT	Seward	WAV	Yosemite	WQY
Paraiso	WRI	Shenango	KTC	Yukon	WBQ
Parthian	KQP	Shenango	SNA	Zapora	WPZ
Pennsylvania	WWI	Shinnecock	KNS	Zulia	KDZ

NOTES

Ship Stations

* Naval or Official.

1. For charged radiotelegrams.

2. For radiotelegrams exchanged with British Coast Stations the coast tax is fr.0·30 per word, with a minimum of fr.1·80 per radiotelegram. For radiotelegrams destined for the United Kingdom a tax of fr.0·35 per word, with a minimum of fr.2·10 per telegram, is charged, including the coast tax and the land line charge.

3. Public correspondence limited to communications exchanged with vessels of the same line, and with the coast stations of Nieuport and North Foreland.

4. For radiotelegrams exchanged between the mail boats and Nieuport or between two mail boats, there is no special ship tax. The total charge for these messages is fixed at fr.1·50 per radiotelegram of ten words or less, and at the rate of fr.0·10 for each additional word in excess of 10. For radiotelegrams between the mail boats and the British Coast Stations at North Foreland, the ship tax is fr.0·10 per word with a minimum of fr.1 per radiotelegram.

5. Public correspondence will be admitted without the application of ship tax if there is no naval correspondence. Private radiotelegrams must be worded in plain language.

6. Identical with the call signal of the British Coast Station at Rosslare.

7. The wave length usually employed is 450 metres.

8. For radiotelegrams exchanged with British Coast Stations the coast tax is fr.0·15 per word, with a minimum of fr.1·50 per radiotelegram. For radiotelegrams exchanged with French coast stations the coast tax is fr.0·15 per word without minimum.

9. The ship tax is reduced to fr.0·15 per word, with a minimum of fr.0·90 per radiotelegram, when the vessel is making voyages between the United Kingdom and ports less than 1,000 nautical miles distant (1,855 km.) from the United Kingdom.

10. For the first ten words fr.4, and for each additional word fr.0·20.

11. Public correspondence limited to radiotelegrams exchanged by this vessel with the coast stations of Scheveningen Port and North Fore-

land, or with other vessels of the Batavier Line. However, when, in particular cases, the vessel follows a route other than the normal, the station performs general public service.

12. Public correspondence may be allowed without the application of ship tax if there is no special correspondence (exclusively official).

13. For radiotelegrams transmitted *via* North Foreland, the coast tax is fr.0·15 per word, with a minimum of fr.1·50 per radiotelegam. However, for radiotelegrams destined for the United Kingdom there is charged, in addition to the ship tax, a tax of fr.0·20 per word, with a minimum of fr.2 per radiotelegram, including the coast tax of North Foreland and the land line charges.

14. Public correspondence may be allowed without the application of the ship tax if there is no special correspondence (exclusively official).

15. Accessory wave of 500 metres for correspondence with Scheveningen Port.

16. Public correspondence limited to radiotelegrams exchanged with the stations of the Scheveningen Port and North Foreland, or with other vessels of the Zeeland Steamship Company.

17. For radiotelegrams transmitted *via* Scheveningen Port or exchanged with other stations of the Zeeland Steamship Company, the total radiotelegraph tax is fr.0·20 per word, with a minimum of fr.2 per radiotelegram. For radiotelegrams exchanged with North Foreland the ship tax is fr.0·20 per word, with a minimum of fr.2 per radiotelegram, and the coast tax is fr.0·15 per word, with a minimum of fr.1·50 per radiotelegram. However, on radiotelegrams destined for the United Kingdom, there is charged, in addition to the ship tax, a tax of fr.0·20 per word, with a minimum of fr.2 per radiotelegram, including the coast tax of North Foreland and the land line charge.

18. Public correspondence is limited to Constantza Tunnel.

19. There is no special ship tax. The ship tax, applicable to correspondence originating on board or destined for Roumanian vessels, is included in the coast tax of Constantza Tunnel.

CALL LETTERS

THE BUREAU INTERNATIONAL DE L'UNION TELEGRAPHIQUE OF BERNE allots to the various nations who are parties to the International Radiotelegraphic Convention combinations of " call " letters which are in turn allotted to ship and land stations. In consequence of the enormous growth of wireless telegraphy, the necessity has arisen for a revision of the list of call letters allotted to signatories of the Convention, and at present the countries named below have had reserved for their exclusive use the letters which are given against their names :—

Great Britain.—All combinations commencing with B, G and M.

Colonies of Great Britain.—Combinations CAA to CMZ.

Greece.—Combinations SVA to SZZ.

Germany.—All combinations of letters commencing with A and D, as well as the combinations KAA to KCZ.

Austro-Hungary and Bosnia-Herzegovina.—All combinations of letters commencing with OAA to OMZ, as well as UNA to UZZ.

Belgium.—Combinations ONA to OTZ.

Brazil.—Combinations EPA to EZZ.

Bulgaria.—Combinations SRA to SRZ.

Chili.—Combinations COA to CPZ.

Denmark.—Combinations OUA to OZZ.

Egypt.—Combinations SUA to SUZ.

Spain.—Combinations EAA to EGZ.

France.—All combinations of letters commencing with F, as well as the combinations UAA to UMZ.

Italy.—All combinations commencing with I.

Japan.—All combinations commencing with J.

Morocco.—Combinations CNA to CNZ.

Mexico.—Combinations XAA to XCZ.

Monaco.—Combinations CQA to CQZ.

Norway.—Combinations LAA to LHZ.

Netherlands.—Combinations PAA to PMZ.

Portugal.—Combinations CRA to CTZ.

Roumania.—Combinations CVA to CVZ.

Russia.—All combinations commencing with R.

Sweden.—Combinations SAA to SMZ.

Turkey.—Combinations TAA to TMZ.

United States of America.—All combinations of letters commencing with N and W, as well as the combinations KIA to KZZ.

Uruguay.—Combinations CWA to CWZ.

There remain, however, the following letters still to be disposed of amongst the remaining countries :—

CUA to CUZ, CXA to CZZ, EHA to EOZ, HAA to HZZ, KDA to KHZ, LIA to LZZ, PNA to PZZ, SNA to SQZ, SSA to STZ, TNA to TZZ, VAA to VZZ, XDA to XZZ, YAA to YZZ, ZAA to ZZZ.

ELECTRICAL MEASUREMENTS IN WIRELESS TELEGRAPHY

By J. A. Fleming, M.A., D.Sc., F.R.S.

EXACT measurement is the very life and soul of all technical applications of science. Unless we are able to weigh and measure the quantities and effects with which we are concerned progress is uncertain and improvements slowly reached. Accordingly at a very early stage in the development of wireless telegraphy attention began to be directed to the measurement of high-frequency currents, resistances, wave-lengths, spark voltages, decrements, and energy losses—all of which are in this subject of prime importance. The great difference between electric measurements made with steady currents and those with high-frequency currents depends to a considerable extent on the fact that the resistance of a wire or strip of metal has a value quite different in the two cases. The resistance of a conductor may be defined as the quality in virtue of which a current dissipates energy in the conductor, and it is measured by the quotient of the total energy loss per second in the conductor by the square of the total current flowing through it. Suppose we have a wire traversed by a current uniformly distributed over the cross-section. We may suppose the wire divided up into very small filaments, such that each carries one unit of current and has a certain amount of energy dissipated in it per second. If, then, we consider the current in one filament to be arrested and that in some neighbouring filament to be doubled, the total current in the conductor will remain as before. The energy dissipated, however, will be increased, because doubling the current in a filament involves four times the rate of dissipation of energy. Hence the resistance or ratio of energy dissipation per second to the square of the total current is increased by this exchange. A little consideration will show, therefore, that the resistance of a conductor is a minimum for uniform distribution of the current over the cross-section, but that any change which makes the current-distribution non-uniform or less uniform will have the effect of increasing the effective resistance of the conductor.

Rapidly periodic or alternating currents keep to the surface of a conductor and do not penetrate below a certain depth into

it, depending on the frequency and conductibility. Hence for such currents the resistance of a wire—meaning by that its energy dissipating power—is greater than for steady unidirectional currents.

Let us imagine an iron bar put into a furnace. If left there it would become red hot all the way through. If it were taken out after a short time and plunged into cold water it would be cooled after a certain time, also right through to the centre. If, however, it was put into the furnace and then into the water alternately at short equal intervals of time, the changes of temperature would be practically confined to a thin layer of the surface, and the deep-seated portions would not partake of these temperature changes. So it is with the production of current in a conductor. The current begins at the surface and soaks inwards, and if the current-changes are very rapidly alternating they are confined to a surface skin and do not penetrate to the inner portions of the conductor.

Mathematical analysis enables us to calculate the ratio of the resistance to high-frequency currents, called the H.F. resistance, to the ordinary or steady current-resistance in a few cases when we know the frequency of the current and the specific resistance and dimensions of the conductor. Thus, consider a circular sectional wire having a diameter *d* cms. and made of a material having a specific resistance ρ in absolute (C.G.S.) units. Then the ratio of H.F. resistance to ordinary resistance for high-frequency currents of frequency *n* is a number equal to the square root of $n\pi^2 d^2/4\rho$ added to $\frac{1}{4}$. Thus if R^1 is the H.F. resistance and R the ordinary resistance, then

$$R^1 = R\left\{\frac{\pi d}{2}\sqrt{\frac{n}{\rho}} + \frac{1}{4}\right\}$$

For instance, consider the case of a copper wire $\frac{1}{8}$ of an inch in diameter to currents having a frequency of one million. Then $\pi d = 1$ cm. nearly, $n = 1{,}000{,}000$ and $\rho = 1{,}600$. Hence $R^1 = 12\frac{3}{4}$ R.

Therefore the high-frequency resistance for the above frequency is nearly 13 times the resistance to steady currents. This shows how necessary it is to take account of the difference.

Supposing, however, that the wire was only 1/100th of an inch in diameter or less, then R^1 would be almost equal to R. This shows that there is a certain smallness of diameter below which a wire has the same resistance to high-frequency as to steady currents. The moral of this is that conductors intended

to carry high-frequency currents of wireless frequency should not be made of thick copper wire, or even ordinary stranded cable, but of a special cable built up of No. 36 or No. 40 silk-covered copper wire bunched and twisted together so that each wire is equally exposed to the surface. The greater the specific resistance of the material the larger will be the size of this minimum wire which has an equal resistance for steady and for high-frequency currents.

In those cases in which a wire is coiled into a spiral it is especially necessary that the wire should be stranded, because, apart altogether from the effect of diameter, the spiralisation of

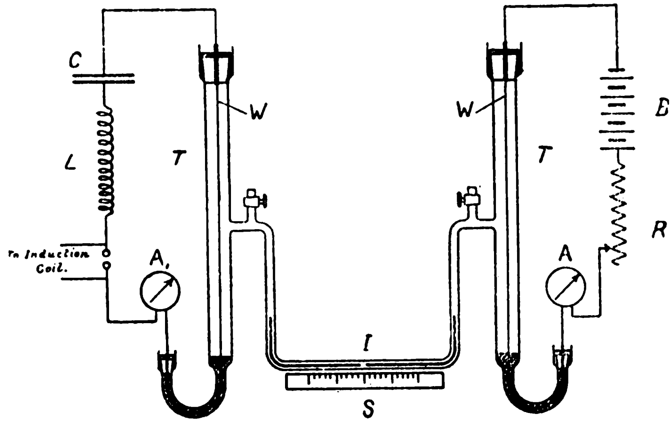

Fig. 1. Differential Electric Thermometer for High-frequency Resistance Measurement. (Fleming).

the wire tends to make the current-distribution over the cross-section more non-uniform for H.F. currents than if the same wire were stretched out straight. Hence a closely-wound spiral of copper wire, say No. 16 S.W.G., has about twice as great a resistance to currents of one million frequency as it would have if the same wire were stretched out straight.

Spiralisation is, therefore, an additional source of energy loss, unless the spiralised wires are made up of very fine insulated wires twisted together.

In those cases in which the H.F. resistance cannot be determined by calculation it can be experimentally measured by an apparatus devised by the writer. This consists of two long glass tubes (see Fig. 1) connected at the bottom by a narrow tube having a bubble of oil in it. Two exactly equal samples of the

wire are placed in these tubes and the tubes closed airtight. The arrangement then constitutes a differential air thermometer, and the bubble of oil remains at rest if the temperature of the air in both tubes is the same. If a steady current is passed through one of the wires and a high-frequency current through the other, and if these currents are adjusted until the oil bubble remains in the same place even after prolonged passage of the currents, we know then that the heat production is the same in both cases, and that the value of the H.F. resistance (R^1) multiplied by the square of the H.F. current (A^2) must be equal to the value of the steady resistance (R) multiplied by the square of the steady current (C^2), or $R^1 \times A^2 = R \times C^2$. Hence, if we measure R and the currents A and C, we can calculate the H.F. resistance R^1. In this manner we can determine the H.F. resistance of a sample of an aerial wire or of a bare copper wire strip or spiral. For such currents as are used in wireless telegraphy the value of R^1 will generally be many times greater than R. We have therefore to measure a high-frequency current, and to do this we must possess a correct high-frequency ammeter. Nearly all the ammeters used in steady current or low-frequency alternating current work are useless for this purpose. The writer has therefore invented an accurate high-frequency hot wire ammeter based on right principles.* It is made as follows (see Fig. 2): On a wooden base two metal discs or rings are fixed, which are connected together with very fine copper or constantan wires, so as to form a sort of barrel or squirrel cage. To the topmost wire a very fine thermoelectric junction of iron and Eureka or copper and nickel is attached, and the thermoelectric wires are continued by wires of the same nature to a pair of thermo terminals, which are connected to a sensitive low-resistance Paul single-pivot galvanometer. If a steady current measured by an accurate ammeter or potentiometer is passed through the fine cage wires it creates heat and causes the thermoelectric junction to give a certain deflection on the galvanometer.

We note this deflection and the value of the steady current through the cage wires and repeat the measurement with several different currents. A curve can then be drawn giving the current through the cage wire corresponding to any observed galvanometer deflection. If we now send through the cage wires a high-frequency alternating current this will produce a deflection on the galvanometer. From the curve we can at once tell the value in

* Made by Messrs. R. W. Paul & Co.

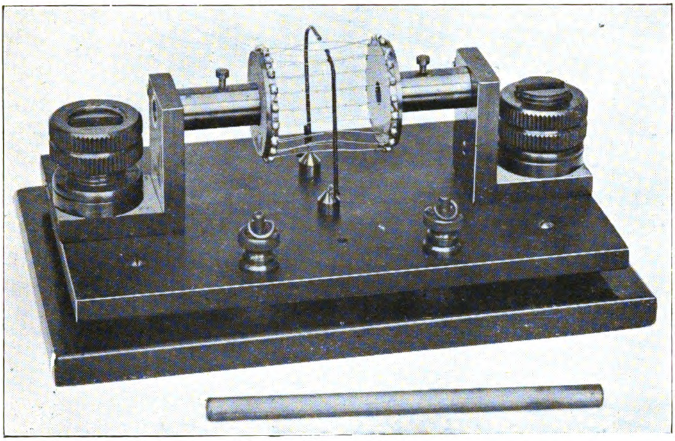

Fig. 2. Fleming Hot Wire High Frequency Ammeter.

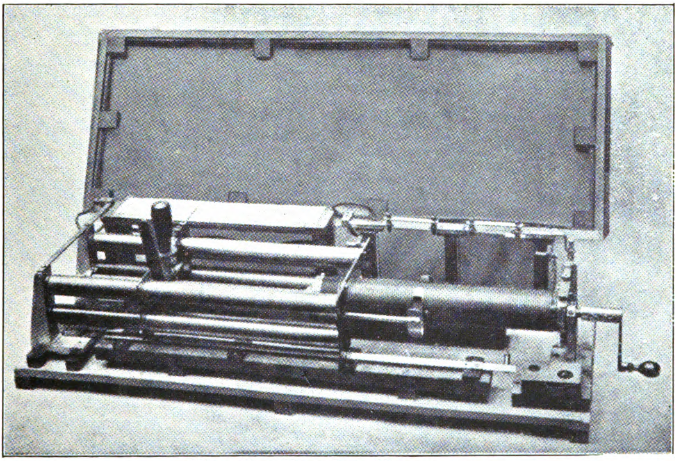

Fig. 3. Fleming Cymometer.

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amperes of the H.F. current producing it. For the cage wires being very fine, their H.F. resistance is the same as their steady resistance, and therefore currents of the same ampère value produce heat in them at the same rate. Ammeters of this type can be made for any range of high-frequency current measurement from the large currents in aerial wires to the small currents in receiving instruments, or cymometers.

A third important measurement in wireless telegraphy is that of frequency or wave-length. If a H.F. current is flowing in any wire and we bring near to it another circuit containing an adjustable capacity and inductance, and place in this second circuit a suitable hot-wire ammeter, it will be found, when the capacity and inductance of the circuit is varied, that the current rises to a maximum value for a certain adjustment of the product of capacity C and inductance L. The square root of C × L is called the oscillation constant of the circuit. The circuit, when adjusted to produce the maximum secondary current, is said to be in resonance with the primary circuit. The frequency n of the oscillations set up in the secondary circuit is given by the formula $n = 1/2\pi\sqrt{CL}$, or, if we measure C in microfarads and L in centimetres, as usual, by $n = (5.033 \times 10^6)/\sqrt{CL}$, we can then determine the frequency at once if our secondary circuit is so arranged as to enable us to tell at once the value of its oscillation constant $\sqrt{CL}$ corresponding to the adjustment to resonance. This is done as follows in the Fleming cymometer (see Fig. 3):—An adustable capacity is formed of two sliding brass tubes separated by an ebonite tube and an adjustable inductance of a spiral wire wound on an ebonite tube. The two are so connected together and to a copper bar completing the circuit that when the capacity is carried by sliding the brass tubes apart the inductance is varied also in the same proportion, and the value of the product $\sqrt{CL}$ for any setting is shown at once on a scale. The circuit contains also a hot-wire ammeter or else a Neon vacuum tube joined across the terminals of the condenser to show when the current or potential in the circuit is a maximum. The instrument is used by placing it near to any circuit, such as an aerial wire, in which there are high-frequency oscillations, the frequency of which it is desired to determine. The cymometer has its oscillation constant varied by moving a handle until the hot-wire ammeter or the Neon tube indicates a maximum reading or glow. A pointer moving over a scale then shows at once the value of the oscillation constant of the circuit, and also of the frequency. The only

objection to this form of instrument is that it is rather long and not very portable. Hence the Marconi Company have brought out a portable form of instrument in which the sliding condenser is formed of semi-circular plates revolving on an axis and the inductance is a fixed coil (see Fig. 4). In place of a Neon tube some form of crystal detector, such as a carborundum crystal in series with a telephone, is shunted across the condenser terminals. The observer then adjusts the condenser until the sound in the telephone is a maximum and reads off on a scale the corresponding frequency or wave-length.

If the frequency of the oscillations in an aerial wire is known, the length of the wave emitted can be obtained at once from the simple formula *wave-velocity* = 1,000 million feet per second = 30,000 metres per second = *frequency* times *wave-length*; or, *wave-length in feet* = 1,000 million divided by *frequency*.

Thus a frequency of 100,000 corresponds to a wave-length of 10,000 feet. The instrument is therefore called a cymometer, which means a measurer of wave-lengths. We can employ the cymometer to make another much-needed measurement—viz., that of the decrements of the oscillations in a circuit traversed by damped oscillations. For this purpose we may take what is called a resonance curve by adjusting the cymometer to various settings and reading the value of the cymometer current and the frequency corresponding to such setting.

Such a curve runs up to a sharp peak. If, then, I_1 is the resonance current corresponding to the primary frequency N_1, and if I_2 is any other cymometer current corresponding to a setting of the cymometer having a frequency N_2, we can find the sum of the decrements of the cymometer and primary circuit from the formula

$$D_1 + D_2 = 2\pi \left(1 - \frac{N_2}{N_1}\right)\sqrt{\frac{I_2^2}{I_1^2 - I_2^2}}$$

The value of the cymometer decrement D_2 can be determined by making another experiment, in which its decrement is artificially increased by an added resistance. If the decrements are small, and if the resonance curve is very sharp, so that a very small variation in the oscillation constant of the cymometer will cause the square of the current in the cymometer circuit to fall to half its resonance value, and if we call O_1 the oscillation constant corresponding to exact resonance and O that corresponding to a cymometer current, which is $1/\sqrt{2}$ of the resonance current,

Fig. 4. Marconi Portable Wavemeter.

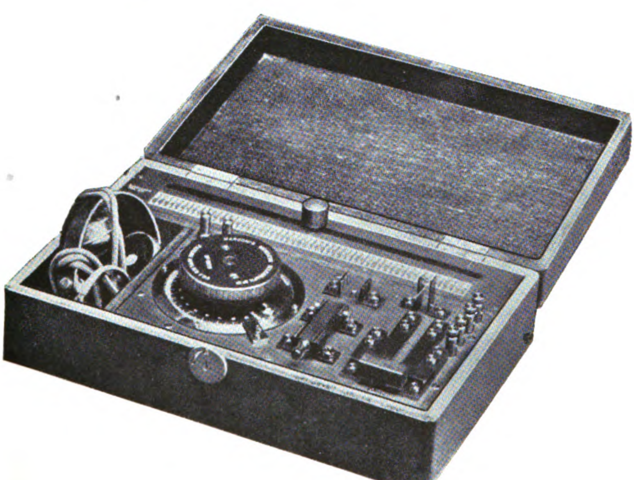
Fig. 5. Marconi Decremeter.

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then the factor under the square root sign in the decrement formula becomes equal to unity, and we have

$$D_1+D_2=2\pi\left(\frac{O-O_1}{O_1}\right)$$

For the above formula, first given by Bjerkes, is obtained on the assumption that N_2 does not differ much from N_1 and since N_1 varies inversely as O_1 and N_2 inversely as O.

If we take two values of O—call them O^1 and O^{11}—above and below O_1 for which the square of the resonance current drops to half its value, and if these are not very different, then we have

$$D_1+D_2=\frac{\pi}{O^1}\left(O^{11}-O^1\right)$$

The sum of the decrements is therefore proportional to the difference of the oscillation constants.

We can separate out the decrement of the primary circuit from that of the secondary circuit by increasing the secondary decrement by a known amount by introducing a resistance into the secondary circuit. The values of the resonance currents in the two cases are given by the formula

$$I_1\ D_2\ (D_1+D_2)=I_1{}^1\ (D_2+d)\ (D_1+D_2+d),$$

where d is the added decrement and $I_1{}^1$ is the reduced resonance current which results. From this equation, combined with the former one, we can find D_1 and D_2.

If we know the decrement of an oscillation circuit, say the condenser or jigger circuit of a transmitter, and if we can measure with a hot-wire ammeter the current in it, then we can at once tell the energy dissipated in that circuit. For thus if D is the decrement and L the inductance, n the frequency and R^1 the high-frequency resistance, then it is easy to show that $D=R^1/4nL$, or $R^1=4nLD$. Suppose, however, we do not know the inductance L, but, which is more likely, we do know the capacity C in that circuit. Then, since $n=1/2\pi\sqrt{CL}$, or $L=1/4\pi^2n^2C$, we have $R^1=\dfrac{D}{\pi^2nC}$. But the rate at which energy is wasted as heat in the circuit is $R^1\ A^2$ where A is the current as read on a hot-wire ammeter. Therefore the power wasted in the circuit is measured by DA^2/π^2nC. If A is measured in amperes and C in farads the energy is given in watts. Hence by the use of a cymometer and a hot-wire ammeter we can at once measure the power expended in heating an oscillation circuit of which we know the condenser capacity.

The Marconi Company has brought out an instrument called a decremeter, which enables an approximate measurement of the decrement of a circuit to be made by the aid of a portable instrument containing a variable condenser and inductance, and also a crystal detector and telephone, by means of which two points on a resonance curve having equal ordinates on either side of a maximum value can be determined both with and without the insertion in the circuit of a small resistance (see Fig. 5). From the readings of the capacity required to do this and a table provided with the instrument approximate measurements of decrement can be taken with very little trouble.

Another important measurement is the energy loss in a condenser, such as a Leyden jar or glass plate condenser. The best way to measure this is to arrange the given condenser in series with an inductance and create secondary oscillations in this circuit by induction from a primary circuit. In this secondary circuit we then insert a hot-wire ammeter and a variable resistance made of such fine wire that its H.F. resistance is identical with its ordinary resistance. Next observe both the current and the frequency in this secondary circuit. Then substitute for the given condenser an air condenser and adjust the capacity of it until the frequency is the same as before. Again adjust the variable resistance until the current is the same as before. The amount of resistance which we have to add to the circuit multiplied by the square of the current flowing through it may be taken as the power loss in the condenser for the current and voltage to which it was subjected in the first arrangement. A number of measurements of energy loss in various kinds of condensers made by this method by the writer were given in the issue of *The Marconigraph* for January, 1912. Operating in this manner, we find that Leyden jars and glass plate condensers generally dissipate quite sensible amounts of energy in their dielectrics and so exert a considerable damping effect upon the oscillations excited by them. Hence it is not a matter of indifference what glass we use in Leyden jars.

Another measurement which is required in certain cases is that of the spark frequency in a discharge. When a condenser is being charged and discharged with oscillations we cannot make any estimate of the amount of power given to the condenser unless we can measure the number of times it is charged per second. For this purpose we must count the discharge of sparks. This cannot be done by the eye, but it can easily be done by the Fleming photographic spark counter. This instrument is a sort

of camera in which the image formed by the lens does not fall directly on the plate, but on to a square-sided revolving mirror driven by clockwork, which reflects it on to the sensitive plate. The plate-holder is not fixed, but is made to slide downwards uniformly by the same clockwork which drives the mirror (see Fig. 6. If then, we point this camera at a rapidly repeated spark and take a photograph, on developing the plate we find it covered with rows of spark images, and by a simple test made with an artificial spark occurring exactly 100 times a second we can graduate the instrument so as to interpret the results and determine the number of sparks taking place per second. It is quite erroneous to assume that when condensers are charged by an

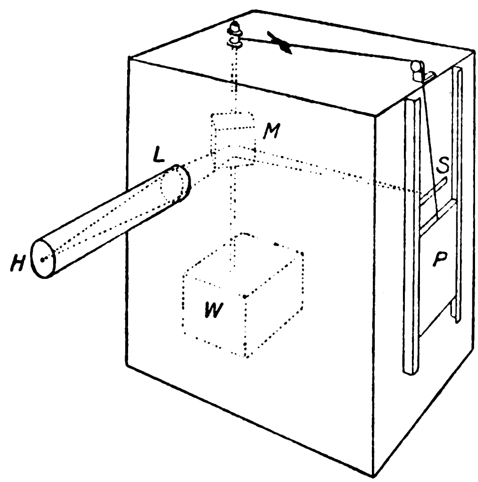


Fig. 6. Fleming Photographic Spark Counter.

induction coil or transformer that the number of sparks per second is the same as the number of interruptions of the coil or alternations of the current.

The above-mentioned appliances enable us to make the necessary tests for determining the efficiency of a radiotelegraphic transmitter, at least within certain limits. The radiotelegraphic efficiency of a transmitter may be defined as the percentage of the total power supplied to it which is sent off from the antenna in the form of long electric waves. If the transmitter is a spark transmitter, and if the current is supplied from an alternator, we can easily determine by an ordinary wattmeter the power given to the transmitter. Unfortunately we do not yet possess any one

instrument which will enable us to measure at once the power radiated from the antenna. We can only therefore arrive at it by difference—viz., by accounting as far as possible for all the internal losses in the plant and considering the difference as radiated. We have first to reckon up the losses in the charging transformer, and this can be done when we know the primary and secondary currents and resistances. From the condenser capacity and the spark voltage and spark frequency we can calculate the power given to the condenser, and from the decrement and measured value of the H.F. current in the condenser circuit we can ascertain the power losses in that circuit, and hence by difference the power given to the secondary oscillation circuit and antenna. If there is an earth connection it is a difficult matter to estimate its equivalent true high-frequency resistance, because, even if we employ an insulated balancing capacity, we do not thereby entirely obviate all energy loss in the earth round the antenna. Nevertheless, if we deduct from the total power given to the secondary circuit the calculated resistance losses in the jigger secondary and in the antenna, the distance gives us approximately the radiation loss of the antenna, but the value will have to be diminished by the unknown amount of the power losses in the earth round the antenna. What is still much required is some method of measuring directly the actual radiation in watts from the antenna, or, at least, determining it by some empirical formula from the antenna current and antenna resistance.

Until we have the means of making this measurement accurately all estimates of radiation efficiency of various forms of transmitter are affected by errors and only approximations at best. This could no doubt best be done by experiments made with a small receiving antenna set up at some distance from the transmitter under test, which receiver when properly graduated would enable a measurement to be made of the radiant energy sent off from the transmitter, just as we measure by a bolometer or radiation pyrometer the radiation from a hot body or from the sun.

WIRELESS TIME SIGNALS

By Arthur R. Hinks, M.A.

(Chief Assistant, Cambridge Observatory).

LIFE is regulated by mean solar time, and an important part of the public duty of a national observatory is to send out the time of the meridian which is adopted as standard for the country. With increasing intercourse by rail and by telegraph it became more and more troublesome to have the time of adjacent countries differ by a number of hours, minutes, and seconds having no obvious meaning, and difficult to remember; and still more was it inconvenient for countries having a great extent in longitude, such as Canada or the United States, to have a bewildering variety of local times in use. Hence arose the necessity of some agreement for the adoption of a prime meridian, and a system of times differing by exact hours one from another.

In 1883 it was resolved by the geodesists of Europe that the meridian of Greenwich should be chosen as the prime meridian, and in the following year a conference assembled at Washington, on the invitation of the United States, to ratify the choice of the prime meridian and to devise a system of Universal Time. The outcome of this meeting was the scheme of Standard Time differing by exact hours from the time of the meridian of Greenwich, which has spread gradually, and of late years more rapidly, throughout the greater part of the civilised world. All the countries of middle and western Europe, with the insignificant exceptions of Holland and Ireland, keep Greenwich time, or an hour fast of it. The United States and Canada have five times, respectively from four to eight hours slow on Greenwich; and similar conventions have been adopted in the oversea dominions and colonies of the Powers which have adopted standard time at home.

It may not be out of place here to say a word on the method of determining time in an observatory. Though the time to be

determined is mean solar time, it is not obtained by observation of the sun, but by stars whose positions with respect to the sun have been determined step by step with high precision during the hundred and fifty years or so of precise observational astronomy. There are many reasons why it is better to employ these "clock stars" rather than make the attempt to use the sun directly. It is sufficient to give one: that a clock star can be observed at almost any hour of day or night when the sky is clear for a short time. The Nautical Almanac gives tables showing the relationship between the sidereal or star time, directly observed, and the mean solar time which is to be derived; thus an observatory obtains its knowledge of time, and is ready to supply it for the public use. The Royal Observatory at Greenwich in this way supplies the time by telegraph to the Post Office, drops time balls at Deal, Portsmouth, and Devonport, and maintains a control on the error of the clock in the Palace of Westminster, familiarly known as Big Ben. The Post Office transmits the time signal at 10 a.m. throughout the country; but since the public are forbidden access to the telegraph instrument rooms, and there is no external signal visible, the Post Office time service has not been of any general public use. It is not putting the matter too strongly to say that accurate time, even to the very moderate accuracy of half a second, has been unavailable, almost unknown.

Nor has it been possible always for an observatory itself to be certain of the time to within this limit of error. In the European winter it will sometimes happen that neither sun or star is visible for several weeks together, during which time it is likely that there have been violent changes in the barometer, with their accompanying effects on the rates of the clocks. Recent improvements in clocks, especially those due to Riefler, of Munich, have done much to minimise this source of error; but it remains true that should Greenwich or Paris desire to be sure of the time to within two or three tenths of a second, they cannot always do so from their own resources. The remedy for this is evidently co-operation. But in the past co-operation would have involved the maintenance of expensive land wires over very long distances if it were to be effective; and in point of fact there has been little or nothing of the kind. Each national observatory has kept its own time as best it could, with little or no help from other observatories of its own country, still less from those of its neighbours.

The invention of wireless telegraphy, and its rapid advance

to a state of comparative perfection, have entirely changed the conditions of the problem. The inauguration of a time service by wireless dates from 1910, when the ***Bureau des Longitudes*** at Paris arranged with the Paris Observatory, and with the military wireless post at the Eiffel Tower, that the latter should send out each night a time signal or series of signals supplied by the Observatory. Not long afterwards a day service of time was established also from the Eiffel Tower; and the German station at Norddeich organised a similar service with time supplied by the observatory of Wilhelmshaven. These services have been in regular operation since their establishment, and already they have become indispensable. In the autumn of 1912 a conference assembled in Paris, at the invitation of the ***Bureau des Longitudes,*** to arrange for a great extension and a great improvement in accuracy. But before we enter on a consideration of what is proposed for the future, let us examine the uses to which this service is available at the moment.

First and foremost is its value in navigation, for the determination of the longitude at sea. It may be well to recall very briefly the principles of the method.

The longitude of a place is the angle between the meridian of the place and the meridian of Greenwich, and it is determined most conveniently as the difference between local and Greenwich time. The local time at sea is determined by sextant observation of the altitude of the sun as near due east or west as possible—that is to say, in early morning or late afternoon; or alternatively by stars observed at the appropriate time of night, and especially in the half light after sunset or at dawn, when the brighter stars are visible and the sea horizon is clearly defined. These observations give the time of the ship. The corresponding time of the Greenwich meridian must be carried by chronometers, or found by the method of lunar distances, or received by wireless. To carry time by chronometers requires that there shall be three at least, while a flagship carries five, and a cable ship, which does the finest navigation in the world, may have as many as fifteen. And while, with the rapid multiplication of time balls in ports and of the number of land points whose longitudes are accurately known, the opportunities of rating chronometers are much more numerous than they were, it is nevertheless true that when a ship has been at sea for some weeks it is not safe to rely on the mean of the chronometers within a number of seconds; and four seconds on the equator is a sea mile. On the other hand, the astronomical

method of lunar distances is impracticable under modern conditions on a fast ship, which vibrates so much that observations of the required nicety cannot be obtained, while the navigating officer has little time for prolonged calculation. Thus longitude has been less precisely known than latitude, until the establishment of the wireless service from the Eiffel Tower and Norddeich has given ships all over the Eastern Atlantic and the Mediterranean that precision of standard time which before it was impossible for them to carry or obtain. So long as the wireless remains at work the ship may be navigated with a single decent watch, and the chronometer relegated to the position of a stand-by should the wireless break down.

In times of peace this is no mean advantage to the security of the ship. In time of war it may well prove invaluable. While there may be some doubt whether the wireless receivers or the chronometers would suffer more in a naval engagement, it is certain at least that it would be more feasible to re-establish the wireless than the chronometers. Moreover, a ship beyond the range of wireless time signals—if such a thing be possible in the near future—has the power to exchange its knowledge of Greenwich time with any ship in range. Wireless has played a spectacular part in mitigating disaster at sea; it seems destined in the future to play the better part of preventing it, by ensuring that a ship need never be in doubt about its longitude.

The precision of the present service of time signals is of the order of a few tenths of a second of time; and this is ample for all the ordinary requirements of navigation, and for most of the other purposes to which it may be put. But it is not sufficient for the refinements of the surveyor, who deals in hundredths rather than tenths. The recent conference at Paris was occupied very largely with the question how to make the service of such accuracy that it can respond to the most exacting demands that may be made upon it. We have now to consider both the means and the need of these refinements.

Leaving out of account the warning signals, the ordinary signal from the Eiffel Tower is composed of three rather long "dots" at intervals of precisely two minutes. An observer listening to the beats of his clock or chronometer can estimate to within one or two tenths of a second the error of his clock on the wireless signal; but it is difficult to be certain always of the precise tenth, and it is difficult also to make the second and third estimates without bias, because of the recollection of the first.

For comparisons of the greatest possible precision some better system is required. Nor is there any difficulty in finding one. Astronomers have long been familiar with the principle of comparing two chronometers, one beating mean time and the other sidereal time, by the method of coincidences. Sidereal time gains half a second in three minutes on mean time. Once in each three minutes, then, the chronometers beat together so closely that the beats appear to be coincident; and it is evident that, by noting the reading of each when this coincidence is produced, one has a comparison between the two very much more exact than can be obtained by simply estimating the proportion in which the beat of one divides the interval between successive beats of the other. In practice it is not usually possible to identify with certainty the exact beat on which the coincidence is perfect, for that would require that the observer should be able to appreciate the three hundred and sixtieth part of a second; but it is not difficult to arrive at an accuracy of about one fiftieth of a second in the comparison of chronometers by this method.

It is proposed, therefore, and the plan is in actual operation, that, in addition to the ordinary signals twice a day, the Eiffel Tower shall send out one or more series of "rhythmic" signals spaced at precise intervals of 0·98 seconds, or gaining one in fifty on the beats of the ordinary clock. This will enable the recipient to obtain comparisons, in accordance with the above principle, to an accuracy of about 0·02 seconds of time. But it is evident that this is far more accurate than the knowledge of the time possessed by a single observatory operating in the usual condition of weather in Europe, where it may be cloudy for a fortnight at a time. Hence it is an essential part of the scheme that there should be co-operation in the time determination.

For some time past there has been a tentative co-operation in working order. Since July, 1912, the Royal Observatory at Greenwich has reported daily to Paris the error of the Paris signal as compared with the Greenwich clock; and it has been open to the Paris Observatory to make use of this information for correcting its signals of the following day, should it appear likely that, owing to bad observing weather at Paris, the Greenwich time was the more secure. Other French observatories have also reported to Paris in the same way, and the system has proved of real advantage. It is this plan which is now to receive a very wide extension, if the proposals of the Conference held last autumn commend themselves to the Governments concerned.

The "*Projet d' organisation d'un service international de l'heure*" was presented to the Conference in the name of the *Bureau des Longitudes* by M. Ch. Lallemand, to whose initiative the scheme itself is mainly due. In adhering, he said, by the law of March 9th, 1911, to the system of standard time based on Greenwich, France had removed one of the last obstacles to the unification of time throughout the world. Fifteen years ago, when one had only the telegraph and the telephone, such an enterprise would have appeared chimerical; but it has now become easy of realisation, thanks to wireless telegraphy, which can send time signals to great distances, in every direction at once, and with a precision which is practically unlimited. But to ensure the full benefit of this new power it is essential that there should be no appreciable discordance between the time sent out from different stations, such as at present occasionally manifests itself in the signals from Paris and Norddeich, for instance. Therefore it is necessary to follow the example of Geodesy and of the science of weights and measures, and to establish a *Bureau central international de l'heure.*

It is hardly necessary to follow in detail the arguments by which M. Lallemand establishes his proposition that this service cannot be entrusted to any one country, but must be truly international, lest there should arise the friction inevitably attending a natural predilection in favour of the time determined at home. But, accepting the principle, let us see how the international service would be organised.

Each observatory affiliated to the service determines the error of its standard clock on Greenwich mean time, and brings up the correction to the moment chosen for the simultaneous comparison of all the clocks. At this moment the standard clock of the central bureau, connected through suitable relays with the central wireless station, sends out the series of rhythmic signals, which are received by all the affiliated observatories, and compared by the method of coincidences with the beats of their standard clocks. Each observatory then deduces its own version of the error of the signals, and reports to the central bureau by telegraph, with a statement of the time elapsed since the last astronomical observations were secured. The central bureau gives to each determination a weight depending on the time elapsed since the last observation, the number of clocks at the disposal of each observatory, and so on; and thus deduces the most probable value of the error of its own rhythmic signals, which is straightway sent out

by wireless as a report to the affiliated observatories. These in their turn apply to their own clocks this correction, to international time; and those of them which control subsidiary distributing stations are then in a position to send out this precise time.

Such is the scheme adopted in principle by the Conference of last autumn. Unlike the majority of such enterprises, it has the advantage of experience behind it. We have seen how on a smaller scale the scheme is already in operation. Before it is officially submitted in detail to the Governments concerned it will have been further elaborated by a commission appointed at the Conference.

The Conference came to the conclusion that the central bureau should be established in Paris, and the Eiffel Tower should serve as the central wireless station. It was further decided in principle that every place in the whole world should be able to receive a signal by night and a signal by day, but that not more than four signals in all per 24 hours should be perceptible at any one place. A preliminary choice of stations results in the following list:—

	G.M.T. of Signal in hours from Midnight.
Paris	0 and 10
San Fernando de Noronha (Brazil)	2 and 16
Harlington (U.S.A.)	3 and 17
Mogadiscio (Somaliland)	4
Manilla	4
Timbuctoo	6
Norddeich	12 and 22
Massana	18
San Francisco	20

But it is not clear at present that all these stations are on the footing of affiliation to observatories, as outlined above. Harlington is in connection with the U.S. Naval Observatory at Washington, and San Francisco with Mare Island. Manilla has an important meteorological observatory which might receive the necessary expansion, and San Fernando de Noronha is doubtless allied with the observatory at Rio de Janeiro. There is no information as to the astronomical relations of Mogadiscio, Timbuctoo, and Massana.

In the above list we note two deficiencies. There is no provision for South Africa or for Australia; and there is no British wireless station in the list. It is natural to express the hope that

these two deficiencies will be filled together. The British Admiralty maintains an observatory of the first rank at Capetown, and the Union of South Africa a young but flourishing observatory at Johannesburg. New South Wales has the observatory of Sydney, and Western Australia that of Perth. Evidently the British sphere of activity in wireless time service lies in the southern hemisphere; and we may be allowed to express the opinion that the Governments concerned will not fall behind in an enterprise so clearly to the particular advantage of the British dominions.

For what are the uses to which this elaborated service of precision will be especially devoted? For navigation and commerce, as well as for a great many scientific purposes, a less precise service, with an accuracy within a second or so, is fully sufficient. The great precision is demanded by geodesy and survey. To take survey first, as a matter in which all countries, and especially new countries, are vitally interested. A possibility of receiving really accurate Greenwich time opens up an altogether new range of possibilities in the task of mapping those great territories which are sparsely settled, and which for very many years cannot afford to pay for the more expensive kinds of precise survey. It is a commonplace of survey teaching that the only finally satisfactory way of surveying a country is to cover it with chains of precise triangulation by theodolite. But it is equally well known that such triangulation is exceedingly expensive; and also that there are great stretches of country in which it is almost impracticable. In flat desert or semi-desert country, or in heavily forested lands, the expense of triangulation is prohibitive. There remains the alternative process of determining the latitude and longitude of a number of stations astronomically. Latitude is easy; there is no difficulty in finding the latitude of a station with all the accuracy desirable, especially when one remembers that excessive precision is thrown away on account of the local deviations of gravity, which amount on the average to a couple of seconds of arc. But longitude has always been a difficulty, because of the impossibility of either carrying the Greenwich time or of finding it in the field by any process readily available. Now that this difficulty is in a fair way of immediate removal we may look forward to a new era in survey. Territories which are unmapped now, and which are likely to remain unmapped indefinitely under the old *régime*, might at relatively small cost be covered with astronomically determined positions one or two

hundred miles apart, which would serve as centres for survey of the surrounding country, as we have seen happen lately in Northern Nigeria along the lines of telegraph.

We have left ourselves no space in which to deal with the more purely scientific aspects of our subject. But they are of no small interest and importance. The stimulus of competition in time determination must have a notable tendency to improve both the clock equipment and the precision of observation throughout the observatories of the world, with far-reaching effects on the accuracy of those fundamental investigations which are the special care of the national observatories. As for geodesy—the measurement of the size and shape of the earth—we may now expect a solution of the long-delayed problem, whether the earth's equator is truly circular or elliptical: a problem beset with difficulty so long as transoceanic longitudes had to be determined through submarine cables, with their perceptible lag in transmission and their limited availability.

It is clear, then, that we have no need to exaggerate the service to navigation, to survey, to astronomy, to geodesy, which is rendered in the present, and will be rendered in much fuller measure in the immediate future, by the establishment of a world-wide time service by wireless. The wide interests of Great Britain and the Empire require that in establishing a chain of Imperial wireless stations we should not neglect the opportunity of contributing, in no small measure, to the propagation of International Time.

THE WIRELESS DIRECTION FINDER

By C. E. Prince.

THE problem of finding the direction from which wireless signals are arriving, as an aid to navigation, is one that has engaged the attention of inventors for some years past; and though various partial solutions have been arrived at, it is only recently that the problem appears to have been completely solved by the development of the Marconi-Bellini-Tosi system.

In the year 1905 Marconi showed that a horizontally bent aerial would radiate and receive most strongly in a direction opposite to the free end; and that the relative intensities in various directions, when plotted out, gave a polar curve of a shape similar to Fig. 1. This type of aerial is now so well known that it is unnecessary to treat of it further.

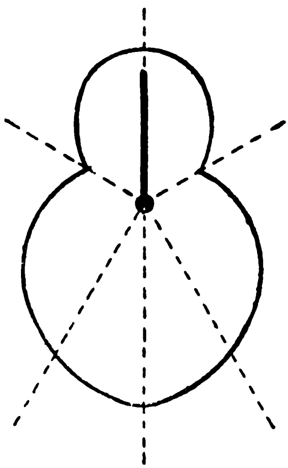


Fig. 1.

Not long afterwards a demonstration was given at Poldhu, by which the direction of arriving signals was found by swinging round such an aerial until the position of maximum strength of signals was found—or rather, in the actual experiment, by connecting the receiver in turn to several such aerials arranged radially.

It is obvious, however, that the indications given by this method were only approximate, and that the necessary system of aerial wires would be very cumbrous; and though this type of aerial remains pre-eminent for transmission, it was not a complete solution of the problem under discussion. As far back as 1899 Mr. S. G. Brown had taken out a suggestive patent for a directive aerial, which was subsequently further developed by André Blondel in 1903, which bears an important relationship to the latest developments, and merits careful attention. The fundamental idea of this device is that of using two vertical aerials, placed half a wave-length apart, and

connecting them together at the base by a horizontal wire, in which the receiver is placed.

Now imagine a wave sweeping over the space occupied by this aerial system, and in its plane (Fig. 2). At any instant one of the aerials will be in a region of electric strain, which differs from that of the other—that is, will be in a different phase position with respect to the wave; and a current will tend to flow from one to the other through the horizontal wire and receiver R. Other things being equal, the maximum effect will obviously be when the aerials are separated by a distance in space equal to half the wave-length; in which case there will be the greatest phase-difference between them. If the wave be proportionally longer than this distance, or (which is the same thing) the base-line be shorter than half the wave-length, the phase-difference will be less, and the intensity of reception less, though otherwise the mode of action will not be altered in any respect.

It must be remembered that this base-line is a distance in actual space, and that it cannot in any manner be avoided, nor can any equivalent be employed: for instance, no additional inductance in the horizontal portion can be equivalent to a further separation of the two aerials. It is thus obvious that (up to the limit of $\frac{1}{2}$ λ) the longer the base-line, the greater the intensity of the received signals will be. The importance of this point will appear when we come to consider direction-finding from shipboard.

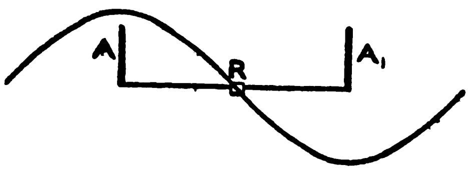


Fig. 2.

Now let us consider the effect of rotating the plane of the aerials, and, to go at once to the limit, imagine it turned till this plane is at right angles to the advancing wave. In this case the wave will, so to speak, strike both aerials simultaneously; there will be no phase-difference between them with respect to the wave, and no current will tend to flow in the horizontal portion. In other words, no signals at all will be received; the intensity of reception will be zero. If the plane of the aerials be not at right angles, but at some other angle to the wave, the intensity will be intermediate; and it can be shown mathematically, and proved experimentally, that this intensity will be proportional to the cosine of the angle between the two planes. If the com-

plete polar curve be plotted, it will therefore take the form of Fig. 3; in which *R x y* is the polar curve of the intensity of signals arriving in, let us call it, the "positive" direction—that is, from the A side of zero direction; and *R m n* is the corresponding curve for signals arriving in the "negative" direction—that is, from the A_1 side of zero direction: for it is easily seen that on passing zero direction the current in the horizontal wire will reverse.

The intensity of a wave arriving in the direction W will then, *ceteris paribus,* be graphically represented by the line *R z.**

These two devices, the Marconi bent aerial, and the above, may be considered as representing the two principal instruments given into the hands of inventors wherewith to attack the problem of direction-finding; and the present writer ventures to propose, for the sake of definiteness and convenience, that the terms "directional" and "directive" should be respectively allocated to them. That is, that an aerial, such as the Marconi bent aerial, in which the directional effect is partial, and dependent upon the proportions of the aerial, and which has no zero direction, should be termed *Directional;* and that any aerial or aerial system which behaves as does the other; in which the directional effect is complete and symmetrical, and which has a definite zero in the right-angle direction, should be called *Directive.* These terms will be thus uniformly employed in the present article.

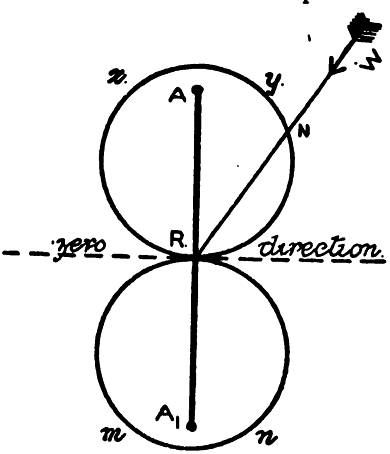


Fig. 3.

Besides the original plan, various suggestions have been at different times put forward for direction-finding by means of directional or Marconi aerials, of which one of the most interesting is contained in a patent of 1909 by Mr. H. J. Round. In this it was proposed to use two such aerials, having their planes at right angles to each other, and with their vertical portions in

* The reader who wishes to go more closely into the action of a directive aerial, will find an excellent article from Dr. Bellini's own pen in *The Marconigraph* for January, 1913.

proximity. If these are arranged upon a ship so that the length of the ship bisects this right angle, then any signal coming from dead ahead will be equally intense on both aerials; but, if from another direction, it will be stronger on one than on the other; and by suitable comparison and calibration this direction can be ascertained. The particular virtue of this device is that, whereas an examination of the polar curve (Fig. 1) will show it to be very flat in the maximum direction, which is accordingly ill-defined; the dead-ahead direction in H. J. Round's patent will be found to fall on a rapidly-changing portion of the two curves, so that this direction is fairly sharply defined; being remarkably so in the negative or astern direction.

The drawback to this device is, however, that it has four points of ambiguity—that is, there are four directions from which signals can arrive, and yet be equally intense on both serials; so that, though it enables a ship to steer accurately towards, or away from, signals whose direction is once known, it does not quite overcome the whole difficulty.

Another very ingenious device for using directional aerials has quite recently been put forward in Germany, which is really a development of Mr. Marconi's original demonstration in 1905.

In this device a shore station is similarly equipped with a number of directional aerials arranged radially, but signals are transmitted over each in turn for a definite period, so that the whole circle is gone round in a certain time. A prearranged signal notifies the beginning of the rotation, and by using a stop-watch, and noticing at which moment the signals are strongest, the operator knows which of the shore aerials is directed towards him. The advantage of this system is that the bearing of such a shore station can be taken by a ship equipped only with its ordinary receiving apparatus; but this seems to be outweighed by the disadvantages: firstly, that the determination can only be very approximate; secondly, that it needs a specially constructed and very cumbersome transmitting station; and thirdly, that it leaves the problem of finding another ship's direction in a fog as far off solution as ever.

Meanwhile, in September, 1907, Messrs. Bellini and Tosi had patented an invention which proved to be the solution of the difficult problem, and, in its latest developments, very well adapted for use on board ship.

The main principle of this invention is the use of *two directive* aerials at right angles to each other, and of an instrument called

the radiogoniometer (or "radio angle-measurer"), by which their indications are compared.

If the reader will refer to Fig. 3, the polar curve of a single directive aerial, and imagine another aerial set at right angles to A A_1—that is, in the plane called "zero direction" in Fig. 3—he will see at once that any change of direction that weakens the effect upon A A_1 will strengthen the signal in the other directive aerial, or *vice versa.* For instance, if the signal come from dead ahead, in the plane A A_1, there would be maximum effect upon the directive aerial A A_1, and zero effect upon the other; for A A_1 would be the zero direction of the other aerial; so that by comparing the strength of the received signal in each aerial by any means, one could discover the angle it made with each. But by the use of the very simple and ingenious device of the radiogoniometer one can do better. This instrument consists of two coils wound over and at right angles to each other, each coil being connected to one of the directive aerials—that is, it is inserted in the middle of the horizontal portion. Within these fixed coils moves a rotating exploring coil, which is connected to the wireless detector or receiver.

Now suppose the signal to come from dead ahead in the plane of A A_1, as above. There will be an oscillatory current flowing in the fixed coil connected with A A_1, but none in the fixed coil connected with the other aerial. If now we turn the movable exploring coil, we shall find that the detector will give the maximum strength of signals when the exploring coil is in parallelism with the fixed coil of A A_1; in other words, our exploring coil will indicate that the signal is arriving in the plane A A_1—that is, it will point out the direction.

This is, of course, the simplest case, but it can be also shown that, for all intermediate directions, the direction and maximum intensity of the combined field of the two fixed coils will necessarily coincide with the direction of the arriving signal, as will shortly appear. The reader who wishes to investigate this more mathematically is referred to Mr. Bellini's own writings; and it has also been proved, by careful experiments, to always hold good in practice with a properly designed radiogoniometer.

At this point the question naturally arises: Does not even this system have *four* points of ambiguity? Are there not four directions indistinguishable one from another? Let us consider a moment.

Take the two directive aerials A A_1, B B_1 at right angles

and draw their polar curves as before, and consider a wave arriving in a direction W. Now with respect to a wave arriving in any direction within the region *q n o,* the polar curve of the aerial A A_1 will be (let us call it) positive—that is, the current at any instant in its fixed coil will be in a certain direction; while it would be reversed, or (let us call it) negative, if it were caused by a signal arriving in the region *q p o.*

Similarly, the region *n o p* would then be positive with regard to the aerial B B_1 and the region *p q n* negative.

But the arriving wave W would affect, and would be in the "positive" region of, both aerials—that is, it would set up currents

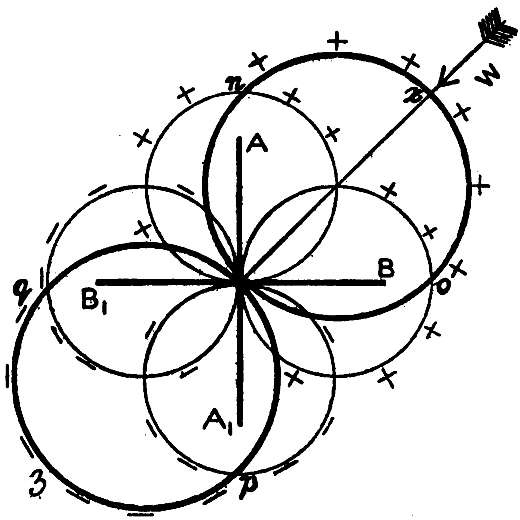


Fig. 4.

in the radiogoniometer's fixed coils in such a direction that the combined or resultant curve would be another figure of eight, of which *n x o* would be the positive and *p z q* the negative portions. And if, as in the diagram, the wave arrived from a direction exactly bisecting the right angle made by the two aerials, it would affect both equally, and the "figure-of-eight" of the resultant curve would then also take up a midway direction, as in the figure. If, on the other hand, it arrived in a more acute direction, it would affect one aerial more strongly than the other. But as it is only the intensity, and not the *modus operandi* of the aerial, which would be affected, one of the aerial "figures-of-eight" would be larger than the other (though of the same shape),

and the resultant curve would be shifted round towards the stronger aerial.

A little consideration will also here make clear another very good point of the Bellini system: its equal accuracy and strength of reception in all directions.

Thus we have not only a simple graphical representation of how the combined field follows the direction of the arriving wave, but we see also that there are not four, but only two, ambiguous directions; for if the exploring coil were turned at right angles to W it would be in the zero position of the combined field.

We are thus able to distinguish exactly the plane of the arriving wave, but not the sense: the detector will not tell us whether we are in our so-called positive or negative region—that is, whether the wave is coming from W, or in exactly the opposite direction.

It is possible to remove this last ambiguity. If in the middle of the system of directive aerials, a plain vertical non-directional earthed aerial be set up, its polar curve is naturally a circle, "positive" in all directions. If this be balanced in intensity of reception with the directive aerials, and a winding introduced into the radiogoniometer so as to combine its polar curve with the figure-of-eight curve of the combined fields, it will be seen that the "negative" portion of the latter will be neutralised, and a new curve of a cardiac shape will be produced having only one direction.

In practice, however, the extra complication of this aerial outweighs the small advantage of its use. For navigation there will be, in most cases, only one possible way of interpreting the indication of the radiogoniometer; and in actual use it is never installed.

We thus see that in the Bellini system we have an invention of the utmost simplicity and directness, which essentially depends for its accuracy, not upon mechanical reliability or exact calibration, but upon unfailing physical law. Nevertheless, to devise from this a thoroughly practical apparatus was not the work of a day.

The original invention was put forward as a complete system of directive wireless telegraphy, and was intended for transmission as well as reception. For the former purpose a large transmitting radiogoniometer was the central portion of the sending apparatus, and served to confine the emitted wave to a plane.

For the purpose of the present article this side of the matter need only be mentioned; but a word about the actual directive aerials used by Messrs. Bellini and Tosi would not be out of place here.

Their type of directive aerial was essentially that of Brown and Blondel, consisting of two open circuit vertical non-earthed aerials, connected together at the base by a horizontal portion; but its *modus operandi* was well thought out. Each aerial—that is, each side of each pair—was made to oscillate to its first harmonic, and was so proportioned that the node of potential appeared just at the bottom of the vertical portion. This was found to give the best radiation and reception. The vertical portion was generally made of high capacity by the use of several wires, and the horizontal part electrically lengthened to the right proportion.

However, this type of aerial had some drawbacks—namely, the cumbersome nature of the aerial, and the fact that where space was limited only very short waves could be used. Both of these, though of much less importance for a land station, were very much in evidence for a ship's installation. It is plain that if two equal aerial systems, whose effect is mainly dependent upon the length of their base-line, are to be installed in the small space available on the deck of a ship, they must be somewhat inefficient; and since the tuning did not permit of much latitude, the inventors were compelled to design for very short wave-lengths, of the order of 100 metres. Moreover, in order to get sufficient capacity into the vertical portions, these were made of multiple wires, and the whole aerial was of an awkward kind, and the range of the apparatus was not very great. Nevertheless the system was fitted up and gave successful demonstrations of its capabilities, especially on the s.s. *La Provence*.

This use of short waves was undoubtedly one of the greatest drawbacks to the system at that stage of its development, for signals of fairly long wave-lengths, such as would be emitted by an ordinary ship or shore installation, were practically useless to it—that is, as fitted on ship-board; and it was proposed to build "Radiophares," or radio-lighthouses, of short wave-length, specially to affect the Bellini apparatus. A few of these radiophares were actually erected on the coast of France; but where there were none, the apparatus could be of little use to any ship having it. Of course, where space was unlimited this defect did not exist, and a large shore station was erected at Boulogne, from

which many most interesting demonstrations of distance transmission were made.

In the meantime the present writer had been experimenting with another scheme for direction-finding (which is covered by a recent patent), which consisted essentially of comparing the intensities of the signals on one directive and one non-directional earthed aerial. If the latter aerial be so proportioned as to "balance" the directive aerial—that is, if signals in the plane of the latter are made equal on both aerials—then we have the means of comparing the strength of any signals on the directive aerial with, so to speak, the strength they would have been had they arrived exactly in its plane, or the maximum direction; and since the difference in intensity is proportional to the cosine of the angle, the latter can be found. In practice the receiver was connected alternately to each aerial by a quick key switch, and the strength of the signals in the non-directional aerial weakened by a rotating coupling till equality was obtained, when the angle through which the moveable coil of the coupling had been turned was equal to the angle made by the arriving signal's direction with the plane of the directive aerial.

The great advantage aimed at in this device was that, for ship work, the whole length of the ship would be available for the directive aerial; which would thus not only be able to employ long waves, but would be a much more powerful receiver, and would also be very ship-shape.

However, its main interest in this connection is that, for the directive aerial, the writer had been employing a closed circuit or loop aerial, tuned with a condenser. This type of aerial is strictly directive, and gives a "figure-of-eight" polar curve exactly similar to the directive aerial hitherto treated of; but it has the advantage that under the given conditions it is a much more efficient receiver and can deal with any wave-length. It is, moreover, simple and convenient for use on board ship. The original Bellini patent does, in fact, claim the use of a closed circuit aerial, but its use was abandoned. The ship aerials were indeed brought near together at the top, till there was an appreciable capacity between them, but the excitation was that of the stationary wave, having nodes and loops of potential; whereas in the closed circuit the current at any instant is the same in all parts of the loop.

It is unnecessary to enter into any further discussion regarding the mode of action of the closed circuit. It is sufficient to say that this type of aerial was found perfectly adapted for use

with the Bellini system, and the latter having been acquired by the Marconi Company it was finally perfected by them under Mr. Bellini's own directions.

The reader of the foregoing will now have a general idea of the problem of finding the direction in which wireless signals are arriving, and the means of its solution. It only remains to speak of the actual apparatus of the latest type, as at present installed on board ship.

In this case each closed circuit aerial consists of a single loop of wire arranged, for convenience, in the form of a triangle, whose apex is supported by an insulator from a triatic stay, or spar. These planes of the two triangles make, of course, a right angle with each other; and in order to get the greatest base-line—which, on an ordinary large ship, can be generally about 50 ft.—are arranged diagonally with respect to the ship's length. Connecting wires are led to the instruments from the middle of the horizontal base wires, which are split by an insulator at their point of intersection. The permissible length of these connecting wires has been studied, and no disadvantage has been found in carrying them for a moderate distance, though, naturally, this, by increasing the possibility of damage, is slightly detrimental to the absolute reliability of the installation, and there is a limiting distance at which the capacity and inductance of the leads added to that of the aerial circuit proper exceeds the allowable maximum for any wave-length. The longer the wave the further can be the instruments from the aerial. The exact position of the aerials, naturally, differs on each ship, and is mainly a matter of convenience. Deviation owing to the ironwork of the ship is practically non-existent, unless the conditions are quite exceptionally unfavourable; and if it exists it is a constant factor that can be allowed for. It is generally convenient that the instruments should be in the wireless cabin, chiefly for silence, and in order to be in touch with the ordinary installation for calling up shore stations, or to disconnect the direction finder, and so protect it before transmitting on the ordinary aerial. But it can equally well be installed in the chart-house, or any other position convenient for a navigating officer, which is connected to the wireless cabin by telephone.

Whatever position be fixed upon, the wires from the aerial system are led direct to the radiogoniometer box, which contains two very accurately paired air-condensers with an adjusting handle, and the radiogoniometer proper. One condenser is

inserted in the circuit of each aerial, and both aerials are thus tuned simultaneously. The construction of the radiogoniometer has been already indicated, and it suffices to say that the moveable exploring coil is attached to a handle and index moving over a graduated scale of degrees, on which the reading of direction is taken.

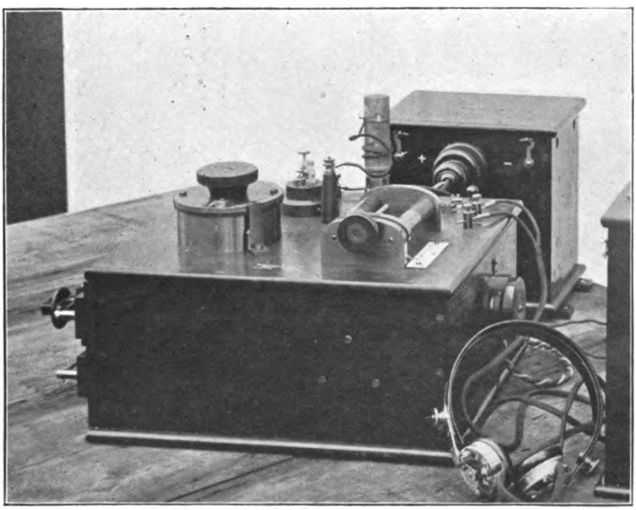
Leads from the moving coil are taken direct to the receiver or detector—which might be any standard wireless receiver, except for the fact that it has been found advisable to make all circuits strictly symmetrical. This receiver can take two forms. It can either be made with a so-called "aperiodic" detector, which requires no tuning, or with a tuned receiver. In the former case some range is sacrificed for extreme simplicity, as there is then—except for the adjustment of the detecting crystal—nothing to be done except to adjust the double condenser and then take the reading. The range, of course, depends upon the power of the transmitting station, and varies from 10 to 50 miles or more. The use of the tuned receiver increases this about 50 per cent.; but for most of the uses of the direction-finder the matter of range is very subordinate to the convenience and absolute reliability of the apparatus. It is worthy of notice here, that, provided the condensers and aerials are exactly paired, the accuracy of the direction-reading is not affected by a slight error in tuning, which at most only weakens the signals and reduces the range.

When the instruments have been adjusted to any arriving wave, its direction, or, rather, the plane of its direction, is indicated directly by turning the index handle of the radiogoniometer till the position of maximum signals is found.

The accuracy with which the direction can be determined depends almost entirely upon the care with which the observations are taken, as the error due to the instrument does not exceed one degree. Of course, any error in laying out the aerials will appear in the result, because they are the base-lines with respect to which the observations are made; but under reasonably good conditions bearings can be taken within two or three degrees, and the error should never exceed five degrees.

The usefulness which this beautiful apparatus will have to shipping can be readily appreciated even by the layman; but it is in time of fog that this will be most striking. For instance, an obvious application of it is to find out whether the ship is on a course which will take it inside or outside of a lightship or isolated lighthouse. A few signals from the lightship will

The Radiogoniometer.



Receiving Apparatus.

[*To face page* 316

settle the question as certainly as if the light were visible. Again, a ship's position can be found either by taking bearings of two fixed stations simultaneously, or by taking two bearings of the same station at an interval of time, while keeping the ship on a fixed course.

In time of fog it will probably become the custom for each ship and lighthouse continually or intermittently to send out a prearranged series of signals, just as now on the foghorn or siren; but if the ship wishes at any time to take the bearing of another ship or station within range it can call up the latter by the ordinary wireless installation, and ask for a few signals for the purpose.

An advantage of the wireless system over any other is the ease with which the fog signals can be made to convey an intelligible message, such as the call letters of the transmitting station, so that it would be easy to discover not only the direction, but the identity of an approaching ship: or a brief recurrent message could give not only this, but its speed, course, or any other particulars.

In conclusion, it is highly probable that this admirable invention may in time find many a sphere of usefulness; but already it has added appreciably to the large debt which humanity owes to the science of Wireless Telegraphy, by promising still further to increase the safety of life at sea.

DISTRESS SIGNALLING

By G. E. Turnbull.

AS navigation has developed from the earliest times, means of signalling from ships to the coast and to passing vessels have been devised and improved, and have been operated under an admirable organisation, but the systems upon which they worked reached their conceivably practical limits long before the invention of Wireless Telegraphy.

Any one of the several systems depended either upon vision or upon propagation of sound, the former being the earliest known.

Lights, flags, rockets, guns, and sirens have all rendered, and are still rendering, inestimable service to navigation, but the disadvantages of visual signalling in the case of fog, and the limitations in range of visual and auditive signalling, even under the most favourable conditions, considerably restrict the usefulness of these methods.

No one can imagine how many lives and how much property would have been saved had Wireless Telegraphy been known of in earlier days. The sight of a pirate in the good old times would not have caused so much anxiety to the skipper of the honest merchantman had the latter been able to call some other vessel to help him with the buccaneer, and no doubt some of our favourite tales of adventure, distress and rescue would never have been written. In the place of them perhaps we would have had more thrilling stories still. Here is a field for some of our novelists of to-day or of the next generation.

It would not be correct to say that the older methods of signalling are superseded by wireless, but it is correct that wireless, with its enormous range of action as compared with that of others, and its independence of weather conditions, is now by far the first of all means of signalling, and by its own intrinsic worth alone places these other systems of signalling in the position of accessories to itself.

When Mr. Marconi had developed his invention to such a point that its utility on board ship became obvious, the Marconi International Marine Communication Co., Ltd., was formed for the purposes implied in its title. The primary object of the new means of maritime wireless communication being to provide additional security to life and property at sea, the company have provided all its ships' stations with emergency apparatus, so that

communication could still be carried on in the event of failure of any kind, particularly at the time of a serious accident which might render necessary the issue of calls for help. In this duplication of parts provision was made against the liability to interruption of the supply of electric current from the ship's dynamos, from which, in the ordinary course, power is derived to work the wireless plant, and a source of current independent of the ship's dynamos was provided as a stand-by in case of failure of the latter. Thus, almost simultaneously with the first application of Wireless Telegraphy to marine communication, the Marconi Company included in its standard wireless installations for ship purposes a suitable battery of accumulators, enabling the ship to issue distress calls, even if all the lights on board the ship were extinguished by water in the engine-room. This was over twelve years ago.

As time went on the organisation of wireless communication at sea became more and more perfect, and it was found desirable to embody in one Circular the various directions which had been given to operators regarding the use of the apparatus in the event of accident to the ship. Thus so long ago as January 4th, 1904, the famous "C.Q.D." call was instituted by the Marconi Co. and embodied in its "General Orders." This instruction, a landmark in the history of the organisation of wireless communications, is reprinted below from the original, which is carefully preserved in the archives at Marconi House.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LIMITED.

CIRCULAR No. 57.

It has been brought to our notice that the call "C.Q." (All Stations), while being satisfactory for general purposes, does not sufficiently express the urgency required in a signal of distress.

Therefore, on and after the 1st February, 1904, the call to be given by ships in distress or in any way requiring assistance shall be "C.Q.D."

This signal must on no account be used except by order of the Captain of the ship in distress, or other vessels or stations retransmitting the signal on account of the ship in distress.

All stations must recognise the urgency of this call and make every effort to establish satisfactory communication with the least possible delay.

Any mis-use of the call will result in the instant dismissal of the person improperly employing it.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LIMITED,
18, Finch Lane,
London, E.C.,
7th January, 1904.

When the "C.Q.D." signal achieved a lasting fame, on the occasion of the wreck of the s.s. *Republic*, many interesting stories were spread about as to its meaning and derivation. Probably the most amusing explanation of the signal was that it indicated "Come Quick, Danger," but perusal of the above Circular will show our readers exactly how it originated. "C.Q." was the recognised signal used by one ship to attract the attention to it of others within hearing, so that telegraphic traffic could be commenced and transacted, and it was thought that the most appropriate distress signal would be arrived at by adding the letter "D." (denoting "Distress") to "C.Q.," the general call to attention.

It is a great compliment to the foresight of the Marconi Company in instituting, as they did at the commencement of 1904, a special distress signal, governing its use by stringent regulations, that the International Radiotelegraphic Convention of Berlin, which entered into force in July, 1908, ratified the practice in regard to distress signals initiated in 1904.

It is a matter of regret to some that the Berlin Convention should have superseded the old "C.Q.D." call by the new "S.O.S." This regret is shared by many of the oldest operators, and even when the new call came into force it is noteworthy that in each case of accident the "C.Q.D." call was sent out as well as the "S.O.S." The change of the call letter is, however, a sentimental regret, and "C.Q.D." is being gradually forgotten.

It is, further, instructive to note that the International Radiotelegraphic Convention which sat in London in June, 1912, endorsed the Marconi practice in regard to emergency apparatus by deciding that all ships equipped with Wireless Telegraphy should have an emergency set as part of their wireless equipment. This prescription comes into effect in July of the present year, but as by far the greater number of the merchant vessels of the world at present equipped with Wireless Telegraphy have been so fitted little change to existing arrangements will be necessary. The United States of America, which was a party to the London Convention, gave effect to the ruling of compulsory equipment with emergency apparatus almost immediately after the London Convention of 1912 was signed.

Much attention has been devoted to the design of apparatus suitable for distress calls, not only of special types, but also with a view to its handling by other than skilled operators. While it is true that a large number of passenger vessels

are equipped with Wireless Telegraphy—and, indeed, only until a short time ago nearly all merchant vessels so equipped were passenger steamers—it is also true that a considerably larger number of cargo vessels are not fitted with this means of communication. Cargo-boat owners have hesitated to incur the cost of the equipment, and the expense of an additional person to be placed on board to operate it. Gradually these objections are being overcome by the simple question of pounds, shillings, and pence, it having been conclusively proved that this expense can be recovered many times over by considerations referred to elsewhere in this volume. With a view of simplifying equipments on small vessels (which in many cases may be able to fully justify the expense of their equipment by receiving distress calls and then proceeding to the assistance of the ship issuing them) it has been suggested that ships be so fitted and the distress call be so arranged that when issued this call should cause a bell to ring or sound a special alarm on board all ships within range.

In the earlier days of Wireless Telegraphy, when very few stations existed, wireless signals were registered by a Morse Ink Writer, or could be made to ring a bell. This could only be done by the use of that detector of wireless signals known as the coherer. This instrument had, however, so many inherent disadvantages, the chief of which were instability, slow rate of working, and necessity for constant attention, that it had to be replaced gradually by auditive reception, and its use at the present day, even for distress purposes only, has now become impracticable. Mr. Marconi, in answer to a question put to him at the Board of Trade Inquiry into the wreck of the *Titanic,* has shown how a distress call could be arranged under present methods of working to ring a bell or give some other alarm in a ship station at a distance, and the method he suggested is now being worked out. Instead of the "S.O.S.," which consists of a series of dots and dashes, several long dashes would be used in transmitting. The special receiver would not respond to ordinary Morse signals made up of dots and dashes, to stray signals from other vessels communicating with each other, or to atmospherical disturbances, but only to a succession of long dashes, being actuated solely by the accumulation of energy in a long sustained dash. It goes without saying that the sustained dash, or series of them, would have to be longer than any existing Morse sign, and would have to be retained solely for the purposes of distress.

In cargo boats, where only one skilled operator is carried,

the advantage of this arrangement is obvious, while in the case of any wireless station where it would be difficult to maintain constant watch at all times its utility cannot be gainsaid.

Meantime the best possible is being done in the way of giving members of the ship's crew an elementary instruction in Wireless Telegraphy on ships where only one operator is carried, to enable them to listen at the instruments while the operator is off duty. A short practice in Morse and in the handling of the receiving instruments will enable any intelligent person with normal hearing to detect the easily-distinguishable "S.O.S." call in the event of its being sent out. He could then at once call the operator back to the station to attend to the communication.

We have referred above to lights, flags, rockets, guns, and sirens as means of distress signalling, and as accessories to wireless. We must not omit to mention as another and one of the most valuable accessories of the present day—namely, that of the Direction Finder, or, as it has been termed, the Wireless Compass. By means of this invention it is possible to detect, independent of weather conditions to which visual means of signalling are subordinate, the direction of one vessel in respect of another. The range of this instrument in the average mercantile equipment extends up to 50 or 60 miles. Neither must we omit to refer to one more invaluable accessory to Wireless Telegraphy in summoning assistance to a distressed vessel, and that is the submarine signalling apparatus. The apparatus is arranged with one receiver on the port side, and another on the bow of the ship, for direction finding, but as the detection of sound by this means is limited at present to between 10 and 15 miles it can only be used as an adjunct to the direction finder, and as a check upon the readings of the latter, should it be desirable to have them up to ranges within these figures.

To describe distress signalling in all its details as it can be accomplished at the present day, and to discuss fully all its possibilities, would fill many pages more, but a general survey only has been attempted here with a view of noting the principal features. If this essay has conveyed to the mind of the reader a fair understanding of what is actually being done and what is still possible, if it has impressed upon him that science and invention are being energetically applied in this direction, under the watchful and encouraging patronage of the Authorities at home and abroad, he will be assured that everything humanly possible is being done to diminish the perils of the sea.

WIRELESS TELEGRAPHY AND THE MERCANTILE MARINE

WIRELESS telegraphy is now recognised as an essential part of the equipment of ocean-going passenger vessels, and, to a rapidly increasing extent, of cargo vessels and smaller craft. It has reached its present position partly through the evidence of its value to ships in distress, but mainly through the experience gained regarding the general usefulness of an extended means of marine communication.

In professional circles of the mercantile marine great importance is attached to the fact that wireless telegraphy has destroyed the isolation of ships at sea. Apart from the anxieties thus relieved, and the risks of loss and delay thus diminished, there are many economies in connection with embarkation and disembarkation which may be arranged now that it is possible to send messages to ships at almost any point of their course.

In the event of a breakdown a wireless message will not only counteract a rise in re-insurance by allaying uneasiness ashore, but also, by the diversity of help it brings, succeed in reducing what might otherwise be a high salvage charge, or even lead to escape from it altogether if the distress summons brings alongside a vessel of the same company.

A master can readily ascertain well in advance the weather conditions on his track—a matter of the first importance in Eastern waters, where hurricanes and typhoons commonly prevail during certain seasons; and he can be advised of the state of tides and bar harbours when approaching from the sea—a matter for his earnest attention, especially on the West Coast of Africa.

In foggy weather, again, a vessel's position can easily be ascertained by wireless; of the presence of floating derelicts, ice or other dangers to navigation she is always in a position to be advised or give advice. Safe and rapid navigation can be materially assisted by the checking of the ship's chronometer by wireless time signals.

Valuable time and tons of coal can be saved by the facilities with which owners of a vessel can get into touch with her for the purpose of changing her course when once she has cleared, and profit not seldom gained by the ability to order a vessel home at top speed to take a special cargo on a sudden rise in freights for a prompt steamer. Time, pilotage, and port dues can also be saved too by advising that bunker coal is not available at a port for which she is making.

Docking, berthing, amount of coal for bunkers, extra stores, space available for cargo, medical officer's attendance, hospital accommodation for accidents, ambulance, baggage, train accommodation, mails, time of arrival—all can now be arranged for in advance by wireless with an immense saving of money and time.

The utility of wireless telegraphy in such cases—and in a hundred other instances that will readily present themselves to any shipowner—coupled with the knowledge that a special section of Lloyd's Register is devoted to ships fitted with wireless apparatus, and that rates of insurance on such ships are considerably lower than on vessels not so equipped, has assured radiotelegraphy an impregnable position in the estimation of shipowners, underwriters, and the travelling public.

The equipment of lifeboats on liners with small installations has already received serious consideration, it being recognised that, in the event of a wreck, such lifeboats could not only remain in touch with one another, but keep oncoming vessels acquainted with their position.

The advance of maritime wireless telegraphy to the indispensable part it now plays in the daily round of a ship at sea has been extraordinarily rapid. At the beginning of 1909, after eight years of development work, there were 125 ships of the mercantile marine fitted with Marconi apparatus. By the end of that year the number had risen to nearly 300; to-day the total is well over 1,500.

On the North Atlantic route, where, owing largely to the establishment by the Marconi Companies of shore stations

in Great Britain, Canada, and the United States, wireless telegraphy has seen its greatest development, 182 vessels, comprising the principal vessels on all the leading lines, are equipped, and many others are in course of being fitted. On the South Atlantic route the figures are also remarkable, and the number of ships fitted during the past two years has increased almost threefold. On South African routes similar rates of increase are to be noted. The opening of stations at Durban and Swakopmund, operated by the South African Government, has given an impetus to the adoption of wireless.

In Eastern waters, from Gibraltar to Shanghai, the possibilities of wireless telegraphy are enormous. Particularly in the typhoon season is wireless voted "a boon and a blessing" by merchants and shipowners with interests centering in the China Seas.

From Shanghai to San Francisco the tale is the same. The Marconi Company has taken over a very large number of vessels equipped by the United Wireless Company, and the American Marconi Company has large orders in hand for vessels trading over this route.

Wireless apparatus, in fact, figures not only on the large ocean liners, but on the vessels on the Great Lakes and the Amazon, on private yachts, lightships, cable-laying vessels, on whalers, sealers, and Arctic fishing boats. And in touch with all these, directly or by relaying, are a large number of land stations.

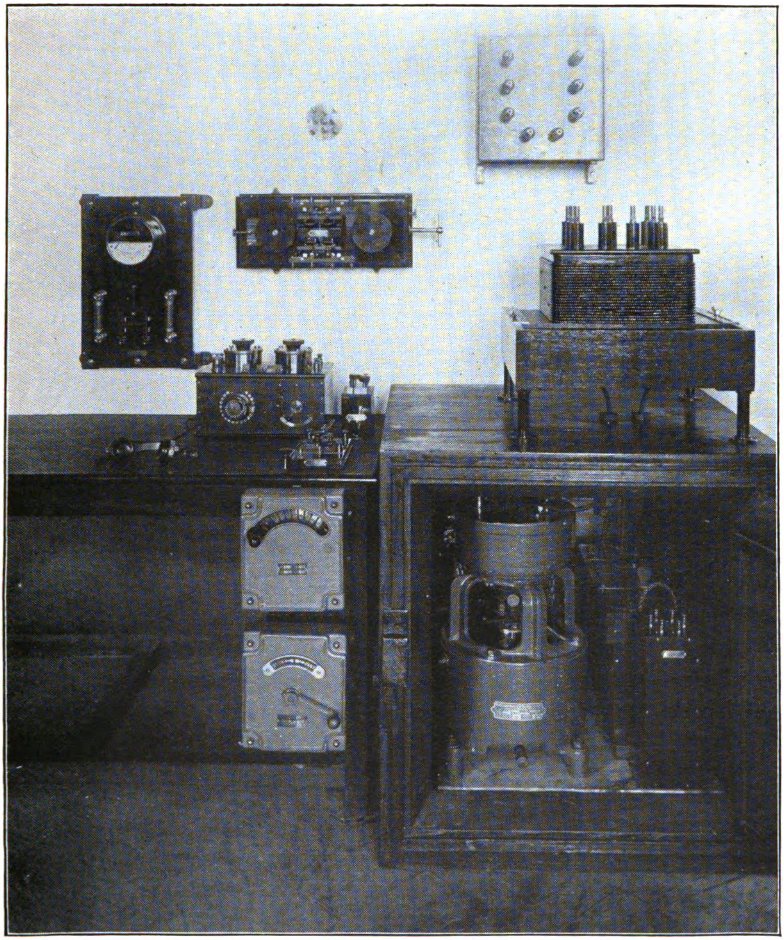
The development of regular communication between an increasing number of moving stations has necessitated not only a carefully devised organisation, but a uniform method of working. This, in turn, has necessitated a practical standardisation of apparatus. At the same time, the demand for absolute reliability in the hands of ordinary operators has led to the evolution of a type of apparatus which is free from complications and is constructed to work continuously without derangement. Most of the working parts are contained in solid boxes, which protect them from damage and limit the responsibilities of the operator to superficial adjustments and the ordinary business of receiving and transmitting messages.

The type of apparatus in most common use for marine intercommunication is known as the 1½ kw. set. It is with this set that the majority of liners and the large passenger vessels traversing the great ocean highways are equipped.

The everyday transmitting range of these sets varies according to the height, length, and shape of the aerial, these factors being determined in turn by the dimensions of the ship. When employed with an aerial having a mean height of 100 ft., the installation is capable of working over a range of 250 nautical miles over water, the maximum range considerably exceeding this figure; while the night range may be anything from two to three times the day range. The 1½-kw. installation is arranged to tune in transmission to waves of 300 and 600 metres, and to tune in reception to all waves between 100 and 2,500 metres.

Recent legislation on the subject of wireless telegraphy in the United States and elsewhere insists upon the provision of emergency apparatus guaranteed to work for a certain length of time in case of breakdown or failure of the power plant from which the wireless apparatus receives its electrical energy. In point of fact, this is merely confirming the practice of the Marconi Company, who have always provided emergency apparatus. In this a battery of accumulators, charged by the ship's dynamo, provides current to work an induction coil.

For cargo vessels, where efficiency with compactness is essential, a special set, known as the ½ kw. cargo set, has been designed. It is a small power installation designed to produce transmitting waves of 300 and 600 metres with a simple change-over from one to any other. Equipped with this set, notable particularly for its economy of space, an owner may send his vessel to sea confident that if trouble arises many other vessels will come speeding to her aid at the first tappings of the key.



$\frac{1}{2}$-kw. Station for Cargo Vessels.

[*To face page* 326

THE MARCONI SYSTEM OF WIRELESS TELEGRAPHY

BY ANDREW GRAY.

THE Marconi system of wireless telegraphy is not any one isolated invention, but the whole of the apparatus and accessories employed for the transmission and reception of telegrams. In approaching the subject of the Marconi apparatus it is necessary to go a long way back, to the time of Mr. Marconi's first Wireless Telegraph patent, and in doing so it is not out of place to recall (for the benefit of those who have forgotten or who have not known) that when Mr. Marconi filed his first patent specification for Wireless Telegraph apparatus, in 1896, the classic experiments of Hertz on the propagation of electric waves had been annually demonstrated in the electrical laboratory of every college of any pretensions in the world for a period of eight years; yet during that time no other suggestion for practical communication by means of Wireless Telegraphy had been made. Not only was Mr. Marconi the first to apply the principles of Hertz's experiments to actual practice, but the method which he then patented remains to the present day fundamentally the basis of all commercial Wireless Telegraphy.

The aim of Mr. Marconi's original invention was the provision of practical means of communication without the aid of connecting wires, and the principal developments since have been directed towards improving the means of communication originally devised. The most important feature of Mr. Marconi's first patent was the earthed aerial—that is, the aerial connected to ground directly or through capacity, so that by virtue of the conductivity of the earth's surface, and the consequent imaginary aerial therein, the true aerial became twice as effective as that of a similar aerial entirely independent of the earth's surface. It is perhaps well to point out here, however, that the great success of the earthed aerial must not necessarily be considered as proving that the unearthed reflector system described in this first patent is useless and obsolete—such is certainly not the case. There are circum-

stances when the reflector apparatus would be preferable to any other if only the difficulties of dealing with excessively short waves with considerable power could be overcome.

In association with the aerial a Ruhmkorff coil was employed, which was at that time the approved means of producing a spark. The apparatus was operated by a Morse key in the battery circuit of the coil. This combination furnished the simplest form of wireless transmitter yet devised—a transmitter which is employed as emergency apparatus on board ship at the present time.

The receiving apparatus consisted of a receiving aerial, a filings coherer, a relay, an automatic decoherer, and a call bell or Morse inker. It is notable from the practical point of view that the coherer was protected from local action by non-inductive shunts across the various circuits of the receiver. Finally, although only applied in an elementary manner, the sympathetic relation between the transmitting and the receiving aerials, which is to-day considered so important for the prevention of interference and for selective working, was specified.

Mr. Marconi's first apparatus contained all the essentials for commercial transmission and reception of telegrams, and the modifications of following years have only resulted in improving the apparatus for its original purpose by increasing the range through increase in power and increase in size and change in shape of aerial; increasing the speed and certainty of working by the employment of dynamo-electric machinery in place of the Ruhmkorff coil, and by the employment of self-acting detectors and telephones in place of the coherer, tapper and relay of the original receiver; increasing the selectiveness by the introduction of independent resonating circuits at the transmitting and receiving ends; eliminating atmospheric disturbances by increased resonance in the receiver, and by the application of balanced circuits and opposed detectors arranged to cause atmospheric interference to minimise itself, and also by the employment of directional aerials; increasing the speed of working beyond the limits of manual transmission and aural reception by the employment of the Wheatstone transmitter at the transmitting end and the string galvanometer and gramaphone at the receiving end; increasing the capacity for handling business by duplexing based on the employment of directional aerials, balanced working and accurate tuning.

The modern Marconi system of apparatus consists of the

mast, aerial and earth; the generator of alternating (or direct) current required for charging the condenser; the condenser and jigger primary circuit with discharger; the jigger secondary with its aerial tuning inductance connected on one side to the earth and on the other to the aerial; the receiving instrument comprising the tuning circuits and the detector.

Generally, for coast stations, there is one high central mast and four subsidiary masts, and the aerial is of the umbrella type, as all round working is required. In the case of stations where inter-communication in a specific direction is desired, two or more masts are employed according to the size and length of the aerial to be supported, and the masts are disposed in such positions as to increase the effect of the signals both in transmitting and receiving by the application of the directive aerial principle. On board ship the aerial is arranged in the most effective way that the masts and rigging of the vessel will permit. The masts of the Marconi System are usually of the sectional steel type built up of standard units, so that within limits they may be made of any height from stock sections. The earth employed at shore stations is of the conduction type, and consists of a number of conducting plates disposed symmetrically around the station, with radial conductors connecting thereto. The number of plates and the number of conductors is determined by the power of the station and the nature of the ground. The earth on board ship is of course the hull of the vessel.

The generating apparatus, that is the apparatus for producing the current for charging the condenser, is usually some form of alternator, which may be driven direct by an engine or by a motor operated off a supply circuit, an accumulator battery, or the supply from a separate engine dynamo plant. The direct driven alternator is naturally the least expensive. The plant operated off the supply circuit (as in the case of a ship) is the simplest and the easiest to work, and has the advantage of being quickly started and stopped, and is available for communication at any time without the attendance of an engine-driver. The alternator supplies current to the primary of a static transformer, which transforms the current to a suitable voltage for charging the condensers. This alternator-transformer-condenser circuit is adjusted so that it is in resonance with the alternator frequency. The voltage of the condenser and its capacity are adjusted so that the magnitude and frequency of the

charge will be properly proportioned to the output from the alternator, and the alternator will be able to charge the condenser regularly to the full extent required. The charged condenser is discharged through a different circuit—the jigger primary circuit—across the disc discharger, which discharger is usually driven from the end of the alternator shaft, and is adjustable in phase relation thereto, so that the discharge of the condenser may be made to take place at the moment the condenser has attained its full charge, thus ensuring regularity of discharge and freedom from arcing.

Generally the condenser consists of alternate glass plates and metallic plates immersed in oil contained in galvanised iron tanks. The connections are wide copper straps, angles or channels. In special cases, for example, where lightness is of importance, condensers of the Leyden jar type, or test tube type, are employed, and in the case of the very large stations at Clifden and Glace Bay air condensers at normal atmospheric pressure are used. The jigger primary consists of one or more turns of individually insulated stranded cable, generally only a sheathing of wire on an insulating core. The jigger secondary consists of turns of stranded wire similar to, but smaller than, the primary, so arranged as to be adjustable in respect to the primary for the purpose of varying the coupling between the circuits. The aerial tuning inductance is similar to the jigger secondary. Where a large inductance has to be employed causing much difference in potential across the inductance, the inductance is subdivided into separate parts. In smaller stations the transmitting plant is operated directly by a manipulating key in the transformer primary circuit, or indirectly by a relay key in that circuit actuated electrically by the manipulating key. In larger stations a special relay key is used in the transformer secondary circuit electrically actuated from the manipulating key. In smaller stations, a spark gap, called an earth arrester spark gap, about $\frac{1}{100}$th of an inch, is placed between the jigger secondary and earth, and the receiver is connected across the gap, the receiver itself being protected by a micrometer spark gap. This arrangement permits the receiver to be left in circuit continuously because the earth arrester spark gap, while serving to discharge the aerial in case of lightning, and acting as an automatic relay for connecting the aerial to earth when transmitting, also leaves the receiver in circuit between the aerial and the earth when the transmitter is not sparking.

To prevent the noise in the telephones produced when transmitting tiring the ear of the operator, the telephone is shunted automatically by the manipulating key whenever the key is depressed. In larger stations the aerial is connected and disconnected from earth by a special electrically actuated switch and the receiver is protected by an automatic electrically operated device as well as the micrometer spark gap. In many large stations an entirely separate aerial is employed for receiving. When duplex working is required the receiving aerial and receiving apparatus are quite separate from the transmitting aerial and transmitting apparatus.

The protection of the apparatus is a specially important point in the Marconi System. In all cases the generators are protected from injurious induced effects from the high frequency circuit by straight filament lamps or carbon sticks across the windings. The transformer secondaries and low frequency tuning inductances are protected against "back-kick" from the high-frequency circuit by air core chokes containing many turns of wire. The condensers are protected against excessive increase of voltage from surging by suitable spark gaps placed at various positions on the bus bars. The aerial and jigger secondary are protected against injury from lightning by the arrester earth spark gap or an equivalent arrangement. The receiving instruments are protected against induced or other effects from the high-tension circuits and from atmospheric electricity by micrometer spark gaps, and by high inductance shunts.

Above has been described the normal type of Marconi station, but an account of the Marconi System of apparatus would not be complete without some reference to such special types as the continuous current stations at Clifden and Glace Bay, the Merchant Ship type, and the Military type.

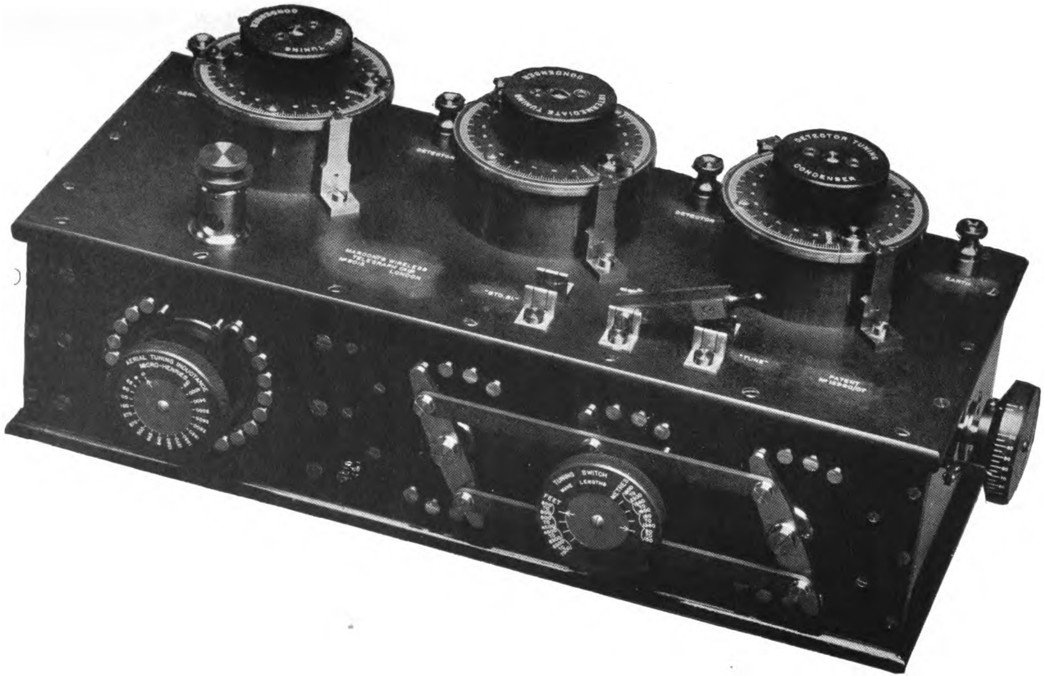
The two large stations at Clifden and Glace Bay, in addition to their exceptional size, have many features of interest. Direct current from high-tension accumulators is employed in combination with a rotary discharger whose speed of rotation is independent of the load. The result of this is a note of a uniformity unapproachable by any alternating current system (where the load always affects the frequency of the alternator) and a spark exceptionally free from arc. The reason for this is, the disc speed being independent of the load, the interval between the passage of two successive discharging studs between the discharging electrodes is always the same, and the rate of charge being

dependent only on the constants of the circuit, the time of charge can be adjusted so that the condenser charging current ceases exactly at the instant of discharge. The condenser is charged from the accumulators, thus allowing a very low value of inductance to be obtained, and consequently a very high note frequency for experimental and other purposes. The operating house is situated some distance from the transmitting station with its running machinery and sparks; consequently exceptional quietness and improved reception is obtained without any loss in accuracy or speed of transmission. Air condensers at atmospheric pressure are employed whereby the condenser becomes practically indestructible, and the condenser plates act as their own protectors. In the event of excess of voltage causing a spark to jump across no damage is done, and the work goes on without interruption.

The most interesting points of the Merchant Ship stations are the arrangement of the apparatus for the convenience of the operator, the "fool-proof" plant, and the provision of emergency apparatus. The operator is provided with a proper operating table, with knee space and drawer for loose papers. This table has ample accommodation for writing, and on it, convenient to the right hand of the operator, is the manipulating key. The receiver is immediately in front of the operator with all its adjustments visible and accessible. The starter of the generator is usually placed within reach of his right hand. The Rhumkorff coil of the emergency apparatus is placed so that the break may be adjusted without loss of time, and the manipulating key of the emergency apparatus is fixed either behind or at the side of the manipulating key of the regular plant. All the transmitting apparatus—generator, transformer, condenser, discharger, jigger, and aerial tuning inductance—are in a special silence cabinet with anti-vibration floor, so that not only is the noise of the generator running and of the spark reduced to a minimum, but everything in the way of high-tension apparatus is shut off from the operator, who has nothing to distract his attention from his proper duties of sending and receiving telegrams.

It is unnecessary to do more than briefly mention military apparatus, as it forms the subject of a special article in this volume.

Apparatus for commercial communication is designed to work with certain definite waves prescribed by international regulations, and communication with these waves is protected against wilful interference by law. In military apparatus



Marconi Multiple Tuner. For adjusting to various wave lengths.

[To face page 332

the conditions are quite different; the apparatus has to be designed for time of war, when the object of the enemy would be to prevent communication by interfering and to intercept communication by taking in the messages being transmitted. Therefore, as it is not possible to work a wave which will not in time be found by the enemy, it is necessary to make use of the time that the enemy takes to find the wave. Military apparatus is therefore designed to give instantaneous change of wave in both transmitter and receiver. As the employment of a large number of instantaneous changes would present very great practical difficulties, and be liable to cause confusion and failure in practice, it is usual to provide a limited number of instantaneous changes with provision for the adjustment of the apparatus so as to permit of different waves being selected for the instantaneous change values from time to time. For example, three combinations, A, B and C, may be provided, so arranged that A may be set to any value between 300 and 600 metres, B to any value between 600 and 900 metres, and C to any value between 900 and 1,200 metres, and when so set, say A to 300, B to 600, and C to 900 metres, working may be changed instantaneously from A to B or C, or *vice versa*. In addition to the special receivers, it is usual to provide an independent receiver continuously variable throughout a long range of waves to intercept the enemy's communication.

The first feature that strikes one in a review of the Marconi apparatus is the aerial. Mr. Marconi's first wireless patent was the vertical aerial with capacity, and is the prototype of all aerials of the present day. Whenever possible Marconi stations are furnished with the directional aerial, because in addition to increasing the effect in the direction of communication, it is economical, as it provides a large capacity aerial of whatever length is required on a system of mast which need not be of excessive height. This aerial has the additional advantage at the receiving end of minimising atmospherics arriving from directions other than the direction of the corresponding station.

For use with the aerial a type of mast has been designed which is convenient for transport, simple to erect and take down, and very substantial and durable.

The generators employed present no complications; they are in no way different in construction from those used for electric lighting and power transmission—true the frequency is higher—but the voltage and speed are normal, and they are

always designed and built by practical dynamo manufacturers.

The transformer employed is equally normal in construction. The secondary voltage is not excessive.

The discharger is of the rotary disc type, which is peculiarly adaptable to simplicity of design and stability of construction, and as indicated before it is positive in action, providing for the discharge of the condenser at regular intervals. By its action the spark gap is practically short circuited at the instant of discharge, and the spark loss reduced to a minimum. The to-and-fro oscillation of energy between primary and secondary is largely prevented by the cut-off action of the rotating studs, and arcing is prevented by the regular timing of the discharge.

In regard to the transmitting jigger, the feature of adjustable coupling and consequent command over the rate of communication of energy from the primary circuit to the aerial is very valuable. As there is always a best coupling of the transmitter for every receiving station, the ability to vary the transmitting coupling means maximum range of communication with each station. The separate primary and secondary windings are also important from a practical point of view because the arrangement avoids earthing the primary or condenser circuit.

The standard receiver of the Marconi system, the magnetic detector, is without an equal for constancy and stability. If signals of a particular strength are receivable at one time the same signals are receivable at any time. No signal nor atmospheric can put it out of action. It has no adjustments to vary, and, but for the clockwork that drives the iron band, there is nothing to get out of order. This instrument made possible the Marconi method of operating without a switch to change from the "transmit" to the "receive" position—in fact, the rapid advance of marine communication has been largely due to the constancy and stability of the magnetic detector. Where a more sensitive receiver is required the valve or the carborundum receiver fulfil all requirements as to constancy, but neither is the equal of the magnetic detector in stability. With all types of detectors a receiving circuit is required. The feature of the Marconi circuit for general use is the provision of a broadly tuned circuit suitable for picking up signals of widely different wave length, and another sharply tuned circuit suitable for working with a minimum of interference after communication has been established, the change from one circuit to the other being made by one simple movement.

Finally, the apparatus employed in the Marconi System can claim to be fully protected (in more ways than one), so that the risk of breakdown is reduced to a minimum. The generators are protected by guard lamps or carbon sticks; the transformers by air core chokes; the condensers by guard points; the aerial and jigger by the arrester spark gap, and the receivers by micrometer spark gaps and high inductance shunts; and lastly, if the main plant in the case of ship stations should fail, the emergency plant is always available.

THE SLIDE RULE.

(Reprinted by permission from the "Engineer's Year Book of Formulæ, Rules, Tables, Data, and Memoranda" for 1913, by H. R. Kempe, M.Inst.C.E. (published by Crosby, Lockwood and Son.)

On the face of the ordinary (*e.g.*, 10 ins.) slide-rule, four scales, usually referred to as the A, B, C, and D scales, are marked. A and D are on the rule, top and bottom, whilst B and C are marked upon the slide, and when the latter has not been moved either to the right or left, the divisions on A and B and also on C and D coincide. The graduation of the divisions of each of the scales is logarithmic—that is to say, the distance from the initial point of a scale to any number thereon represents the logarithm of that number.

The A and B scales are divided into primary graduations representing the logs of the numbers from unity to 100, and these divisions are each subdivided into ten secondary divisions. These, towards the left-hand side of the scales, are further subdivided, but as, in the progression towards the right-hand side, the primary divisions approach one another rapidly, it is not possible to carry the extreme subdivision throughout the scale. Inspection of any rule will show the extent to which such division is practicable.

The C and D scales are divided similarly to the A and B scales, but here there are only ten primary divisions spread over the same length of scale as the 100 in the A and B scales. This admits of a greatly extended subdivision, affording a somewhat greater facility for accuracy in calculation. It may be observed here that the ratio between the two sets of scales involves the fact that the figures on the A and B scales are the squares of those on the C and D scales; conversely the figures on the C and D scales are, of course, the square roots of those on the A and B scales.

Most rules are also provided with a sliding runner, referred

to as the "Cursor," which is enabled to slide along the length of the rule parallel to the scales. The cursor usually consists of a small frame carrying a glass window upon which a transverse hair line is marked, or else it is provided with four indices arranged in a transverse straight line. The cursor enables the figures or graduations of the slide to be set readily against those on the fixed scales, and also enables any reading to be marked temporarily during the manipulations of the rule.

It may be added that the extreme left-and-right-hand graduations of the scales are referred to as the left-and-right-hand indices respectively.

Multiplication.

$$(a \times b \times c \ldots n = x)$$

It is obvious that although the figures on the scales start with unity, any multiple or sub-multiple of the value of 10 may be assigned to the indices provided that such value is adhered to throughout each complete operation. This holds good whatever be the nature of the calculation involved.

To multiply the left-hand index of the slide is set to the multiplicand on the rule, and against the multiplier on the slide will be read the product on the rule. In this operation the length equivalent to the log of the first number is added to the length corresponding to the log of the second. Should there be more than two factors, the result of the first setting as above is not read, but the cursor is set thereto and the slide index brought up to the cursor setting, when the product is read as before, and so on to any number of factors. As continuous progression of the slide from left to right would bring the ultimate reading beyond the scale, it should be noted that the right-hand index may be used to the cursor; this will bring the product within the scale.

The number of digits, *i.e.*, the position of the decimal point, may be evident from the factors. If such be not clear, however, it may be taken that the *sum* of the digits in the factors *less* the number of times the slide has been projected to the right will give the number of digits in the product. On some rules the cursor is provided with a movable index for registering the number of times the slide has been projected to the right.

Division.

$$\left(\frac{a}{b} = x\right)$$

This involves the *subtraction* of the logs of the numbers,

therefore the process is exactly the reverse of multiplication, *i.e.*, the divisor on the slide is set to the dividend on the rules, and against the index of the slide will be the quotient on the rule. The number of digits is found by *adding* the number of times the slide is projected to the right to the *difference* between the divisor and dividend.

PROPORTION—DIRECT AND INVERSE.

$$\text{Direct } \left(a : b :: c : x, \text{ or, } c \times \frac{b}{a} = x\right)$$

Bring the first term on the slide to the second on the rule, move the cursor to the third on the slide, and read the fourth on the rule.

$$\text{Mean proportional } \left(\frac{a}{x} = \frac{x}{c}\right)$$

Set index on B to a on A, bring cursor to C on B; read under cursor x on D.

The procedure for inverse proportion is the same, save that the slide is *inverted*, so as to bring the A and C scales into juxtaposition.

SQUARES AND SQUARE ROOTS.

Squares and square roots are found by setting the cursor and reading from D to A or *vice versa*.

CUBES AND CUBE ROOTS.

Cubes and cube roots as well as all higher powers and roots are best found by the use of logs, which may be read on the back of the slide of most rules if the C index be set to the number whose log is required on D. The log is then multiplied or divided by the power involved. On certain rules the D scale is replaced by a log of a log scale designed by Professor Perry; this facilitates the finding of high powers and roots; thus

$a^n = x$; set the index on C to a on D; against or on C, read x on D.

$$\sqrt[n]{a} = x, \text{ or, } a^{\frac{1}{n}} = x.$$

Set n on C to a on D; against index on C, read x on D.

SINES AND TANGENTS.

These may be found by setting the slide as in the case of the log of a number, the values being marked on the back of the slide with the log values.

On the back of most rules will be found a number of "gauge-points" useful for various special calculations.

PRINCIPLES OF WIRELESS TELEGRAPHY EXPLAINED BY MECHANICAL ANALOGIES

By Captain H. Riall Sankey, R.E. (Ret.), M.Inst.C.E.

ELECTRICIANS who have to deal with alternating currents have no great difficulty in realising how an electric spark can produce high-frequency oscillations and can initiate the electro-magnetic waves required for wireless telegraphy, and further, how these waves can be detected at a distant point, and how the receiver-circuit can be tuned so that only selected wave-lengths become operative.

To others, however, a mechanical analogy is helpful. Many such analogies can be devised, and the following have been selected :—

The Hertz high-frequency oscillator consists of round copper plates, to which are fixed stiff wires terminating in spark balls, and shown in Fig. 1. When suitably connected to a source of

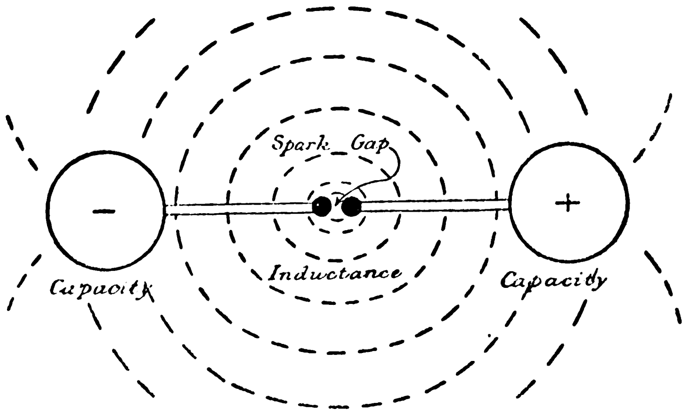


Fig. 1.

electricity so as to continuously increase the electrical charge, the tension across the gap will in due course reach the point at which the air resistance is broken down, and a spark—or, more strictly, a succession of sparks—will fly across the gap. In the mechanical analogy shown in Fig. 2 two cylindrical vessels represent the copper plates, the tube corresponds to the stiff wires, and the diaphragm in the middle of the tube to the spark-gap. The right-hand vessel is gradually filled with

water, and as the water rises the pressure on the diaphragm increases; and if, when the water-level reaches the level shown in the figure, the diaphragm bursts (corresponding to the breakdown in the air in the spark-gap), the water will rush from vessel

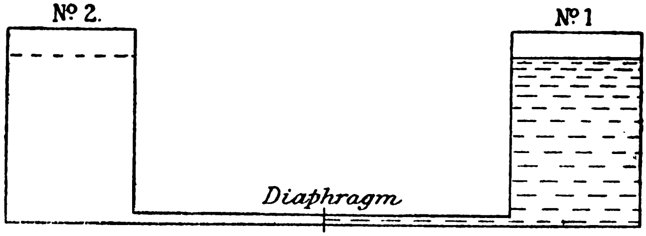


Fig. 2.

A to vessel B. It is supposed that the water supply stops at the same instant. Assuming for the moment that there is no friction in the pipe, the vessel A will be completely emptied, and the vessel B will be filled to the same level as originally obtained in A. The water will now rush back into A and reach its previous level, and so on indefinitely.

Let it now be supposed that there is considerable resistance in the pipe, the flow will then be comparatively slow; the water will rise to the mid-level in B and will drop to the mid-level in vessel A, and there will be no oscillation. Precisely the same happens with a Hertz oscillator if the resistance of the wires is too great.

For small values of resistance in the tube the water will not rise in B to the same level as in A—in fact, the difference between the level reached and the original level is a measure of the resistance —and, on the return to vessel A, the level reached is still further reduced, until after a few oscillations the water will come to rest.

The motion can be represented by a series of waves whose height represents the level of the water reached alternately in each vessel, which height becomes less and less, as shown in Fig. 3. Such a series of waves is known as a "damped train of waves."

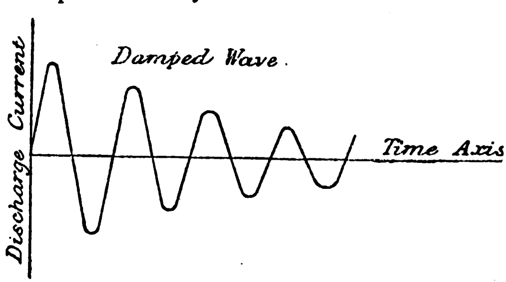


Fig. 3.

If it is supposed that the vessels, instead of being of glass, are made of india-rubber, as in Fig. 4, then the vessels will expand each time they are filled, and they will contract each time they are emptied. A pulsating motion will be thus produced, causing pressure waves in the air, which will travel in all directions with the velocity of sound. The energy expended in thus producing air-waves will be radiated, and the damping of the amplitude of the water oscillations will thereby be increased, so that the water will come to rest more quickly than it did with the glass vessels.

These air-waves correspond to the electro-magnetic waves which can be considered as being formed by the lines of stress indicated in dotted lines in Fig. 1, being, so to speak, detached from the plates and started travelling through space at a velocity which is equal to that of light, namely, 186,000 miles per second, or 300 million metres per second. At each oscillation a wave will start, and the time interval between the crests of the successive waves will be the time occupied by one oscillation.

Fig. 4.

If one of the plates in the Hertzian oscillator is increased in size, and the conductor from it to the spark-ball is correspondingly reduced in length, as shown in Fig 5, no alteration will take place in the lines of electric stress starting from the other plate. In fact, the lower plate may be practically infinite in size, or, in other words, may become the Earth, as shown in Fig. 6. This is the modification of the Hertz oscillator conceived by Marconi, and was the initial invention of wireless telegraphy.

It is not necessary to have a plate on the top of the conductor, because the capacity can be obtained by means of a sufficient length of plain wire. This wire is technically known as the aerial, and is shown in Fig. 7.

A plain aerial, such as above described, radiates energy rapidly, that is to say, it is a good radiator. The consequence is that after each discharge there are only three or four rapidly damped oscillations, whereas a much greater number is necessary

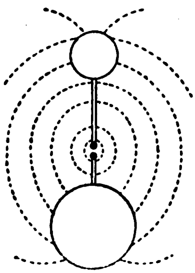


Fig. 5.

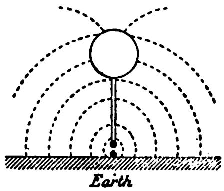


Fig. 6.

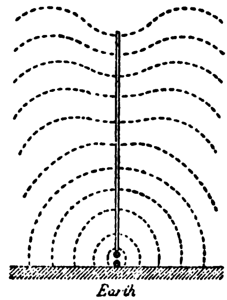


Fig. 7.

for long-distance work. Moreover, if the voltage of the charge is too great, the air breaks down at the top end of the aerial by what is known as a brush discharge, and thus a limit is fixed to the energy which can be imparted to the short train of electromagnetic waves. The practical result was that the maximum range obtainable was about 70 miles.

A mechanical analogy to this brush discharge is given in Fig. 4. If the india-rubber vessels are fitted with loaded valves at the top, and the water is admitted under pressure, these valves will open and the water will spurt out if the pressure exceeds

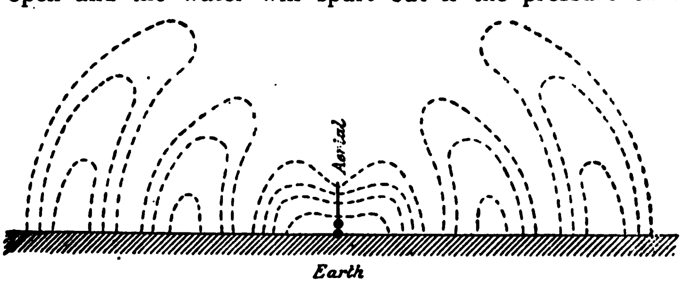


Fig. 8.

a certain amount. The water so wasted corresponds to the electricity wasted by the brush discharge.

What is wanted for practical wireless telegraphy is some means of impressing a large amount of energy on the aerial

without requiring too great a voltage, and at the same time producing a long series or train of waves with very little damping. To obtain this effect Marconi made his next important invention, and it is the subject-matter of the celebrated 7777 Patent. The improvement described in this patent is the foundation of all the practical wireless telegraphy of to-day, and it immediately increased the range (over water) from 70 miles

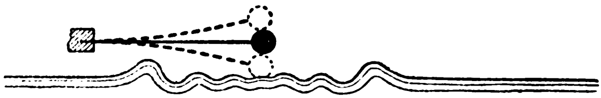
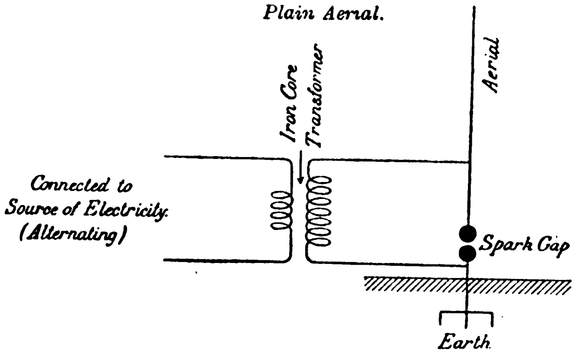


Fig. 9.

to 250 miles, and has enabled the commercial working at a range of 2,000 to 3,000 miles to be successfully carried out. By commercial working is meant the capability of being able to send wireless messages at all times, that is, in the daytime, and not only at night. A mechanical analogy will explain this improvement in a simple manner.

If a weight is dropped into still water, concentric wavelets will be formed. If the weight is too large or the height from which it is dropped is too great, not only will waves be formed but there will be splashing, and this splashing corresponds to the brush discharge already referred to. If the weight be fixed to a horizontal spring, as shown in Fig. 9, and a force is momentarily applied to the weight, it will oscillate in a well-



Plain Aerial.

Fig. 10.

known manner. It will hit the water, and each time it does so it will produce waves in the manner already pointed out, and if the energy is too great there will be splashing as well as waves. The corresponding electric circuit is shown in Fig. 10.

A smaller weight placed underneath the big one, as shown in Fig. 11, held up by a horizontal spring, will also form an oscillatory system, and will be put into motion by the large weight first hitting the small weight, which, in its turn, will hit

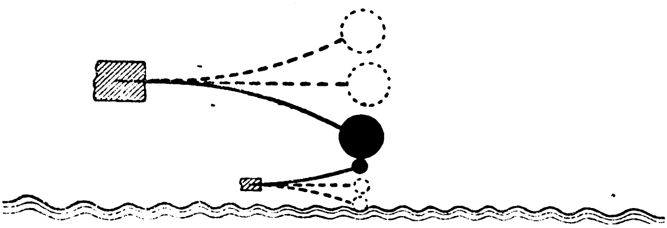


Fig. 11.

the water and produce the waves. Obviously matters can be so arranged that the energy imparted to the small weight at each impact is sufficient to produce the maximum amount of wave without any splashing. A succession of waves will be produced, and gradually the whole of the energy originally imparted to the big weight will be converted into wave energy.

It is obvious that a necessary condition to carry out this effect is that the small weight shall always be just at the top of its path as the big weight comes down to hit it, and it follows that the period of oscillation of both must be the same (or in harmonics), that is to say, both oscillatory systems must have the same time-period, or, in other words, they must be tuned.

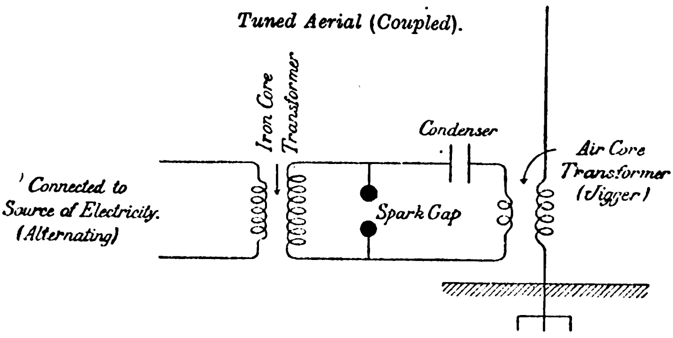


Fig. 12.

The corresponding electrical arrangement is shown in Fig. 12, and it consists of an oscillatory circuit into which a large amount of energy can be put (corresponding to the large weight and spring in Fig. 11), and an aerial oscillatory circuit

(corresponding to the small weight and spring), which receives energy from the oscillatory circuit and radiates it in the shape of electro-magnetic waves. These two circuits must have the same period—that is, must be tuned—and they are inductively connected by means of a transformer, the primary of which is in the oscillatory circuit and the secondary in the aerial circuit. This transformer is called a "jigger." The amount of coupling of a transformer depends on the relative position of the coils, and is represented by 100 per cent. at its maximum, and this degree of coupling occurs when the coils are absolutely concentric; when they are at right angles to each other the coupling is zero. When the degree of coupling is 100 per cent., all the energy (apart from losses) is transferred from the primary to the secondary in half a cycle, but as it is desired to transfer only a small portion of the energy at each oscillation from the primary to the secondary, the degree of coupling must be small. In wireless telegraphy the coupling is generally about 6 per cent., or even less.

With the long train of waves produced as just described by means of a loosely coupled transformer, a cumulative effect is obtained, and then other classes of receivers are more sensitive than the original "coherer"; no relay is needed, and the signals are obtained in a telephone. Moreover, the receiving apparatus can be so arranged that it will not respond to signals sent out with other wave lengths than those to which it is tuned. In this way a receiving-station can isolate itself from other wireless stations, and is thus not interfered with when receiving a message. Hence by the arrangement shown diagrammatically in Figs. 13 and 14, two advantages of the highest importance are obtained, namely, greater energy distributed from the transmitting aerial and isolation.

In Fig. 13 the mechanical analogy adopted for explaining the action of an inductively coupled aerial is reproduced on the

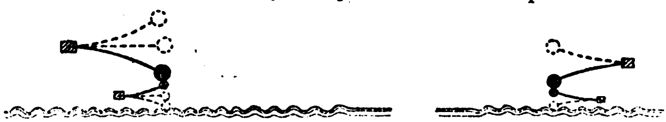


Fig. 13.

left, and on the right there is a similar analogy for an inductively coupled receiving aerial. The succession of small waves keeps the small weight system at the receiving-station in a state of vibration during the whole time of their passage, and the repeated,

properly timed blows which this weight gives the large one put the latter into motion, and thus the major portion of the wave energy is transferred to the large weight.

The electrical equivalent, which is shown in Fig. 14, is that the train of electro-magnetic waves maintains oscillations in the receiving aerial, which are inductively transmitted to the oscillating circuit, and, being properly timed, the energy is accumulated therein and becomes sufficient in amount to actuate the receiver and give signals in the telephone.

It will be noted that, in the mechanical analogy, unless the time-period of both the small and large weight systems is the same as that of the waves, there will be no accumulation of energy in the large weight system at the receiving-station, and, correspondingly in the electrical case, the energy transmitted to the oscillating circuit will be insufficient to actuate the receiver. Clearly, therefore, the oscillating circuits and the aerials at the

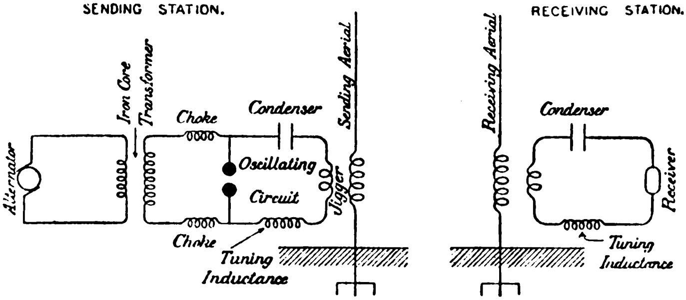


Fig. 14.

sending and at the receiving stations must be tuned to the same period, which must be the period adopted for the electro-magnetic waves.

The essence of the whole matter is that in wireless telegraphy everything must be tuned, that is to say, must be in resonance, and the apparatus must be designed for this purpose. By tuning the various sending and receiving stations, they can communicate with each other without interfering with or being interfered with by other stations.

It is interesting to note that in every other department of engineering resonance has, with few exceptions, to be avoided, and it is only necessary to refer to breakages of shafts, vibrations of steam-pipes, nuisances caused by vibration, surges in high-voltage transmission lines, etc.

The following simple experiment, described by Mr. R. D. Bangay, may assist in making Wireless Telegraphy clear :—

In a pool of water, and at opposite sides of it, float two pieces of wood. These two pieces of wood represent the antennæ of two wireless stations, and the water between them represents the ether.

Now if one of the pieces of wood is struck with a hammer, or in any other way caused to disturb the water, it will be noticed that a number of ripples or waves are sent out in all directions. By following these waves until they reach the piece of wood at the far side of the pool it will be noticed that this piece of wood is set in motion by these waves.

The following will be observed on analysis :—

(1) The "transmitting" log of wood does not move from its relative position to the "receiving" log of wood.

(2) It does not send out nor radiate any particles of itself.

(3) The actual particles of water do not travel from one end of the pool to the other. The wave travels, but if any particle of water were to be closely watched, it would be found that it moved up and down in a vertical direction.

(4) The "receiving" piece of wood does not absorb any of the water, but merely converts the wave motions of the water into a mechanical movement of itself, and this movement could be translated again into a visible record by some simple attachment in connection with a pencil.

We have here a very good analogy of two wireless stations: the hammer corresponds to the transmitter, the pieces of wood correspond to the antennæ, the water to the ether, and the pencil attachment corresponds to the receiver.

A more complete hydraulic analogy, devised by Mr. J. St. Vincent Pletts, is reprinted from the *Marconigraph;* in Figs. 15 and 16 the water and electrical circuits are made to correspond as nearly as possible, the analogous parts being marked with the same letters, but the two cases being distinguished by capital and small letters respectively.

The generator, Figs. 15 and 16, consists in the water case of the propeller "G" enclosed in a cylinder, and in the electrical case of the dynamo "g." When the propeller is rotated a pressure or head of "hydromotive force" is created, which is measured in units called pounds per square inch. Whether any

water flows or not, the pressure is there. Similarly, when the armature of the dynamo is rotated a voltage, or potential, or electromotive force is created which is measured in units called volts. Whether any current flows or not, the voltage is there.

The condenser consists in the water case of an elastic diaphragm " C " stretched across a cylinder, and in the electrical case of two conducting surfaces separated by a layer of insulating material " c." When a difference of pressure is created water is sucked out from one side and forced into the other side of

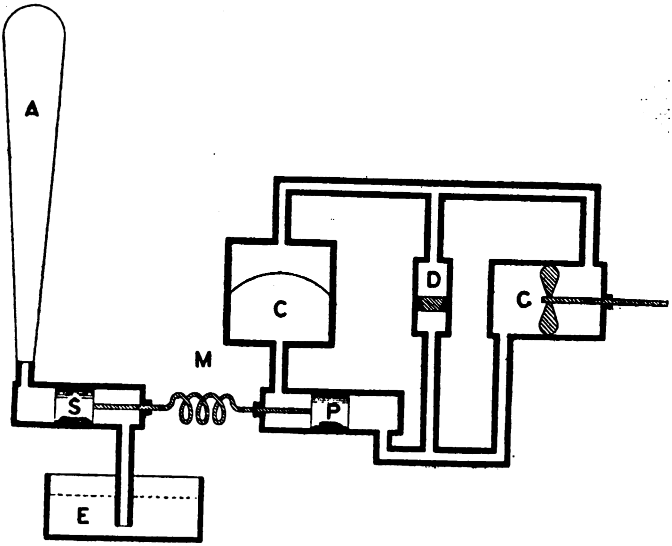


Fig. 15.

the condenser, bending the diaphragm " C " to an amount depending upon the pressure and the elasticity of the diaphragm " C." If any path be provided for the water to get from one side to the other of the diaphragm " C " it will return to its normal position. Similarly, when a difference of potential is created, electricity flows out of one side and into the other side of the condenser " c," which becomes charged to an amount depending upon the voltage and the capacity of the condenser " c." If a conductor be connected to the two sides of the condenser " c " it will discharge itself.

The discharger consists in the water case of a sticky valve " D," and in the electrical case of a spark gap " d." When the pressure reaches a certain amount the valve " D " flies open

(allowing free passage to the water), remains open a short time, and then falls back into its seat, where it sticks until the pressure is again sufficient to force it up. Similarly, when the voltage reaches a certain amount, the spark gap "d" breaks down (allowing a free passage to the current), remains conductive for a short time, and then becomes non-conductive until the pressure is again sufficient to break it down.

The primary inductance consists in the water case of a heavy piston "P" running in a cylinder, and in the electrical case of a coil of wire "p." When water flows it moves the heavy piston "P," which, owing to its inertia, is difficult to set in motion, or when in motion to stop. Similarly, when a current flows it creates in the coil "p" a magnetic field which is difficult to create, or if created is difficult to stop.

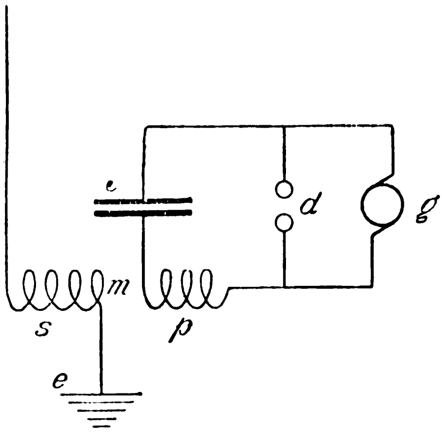
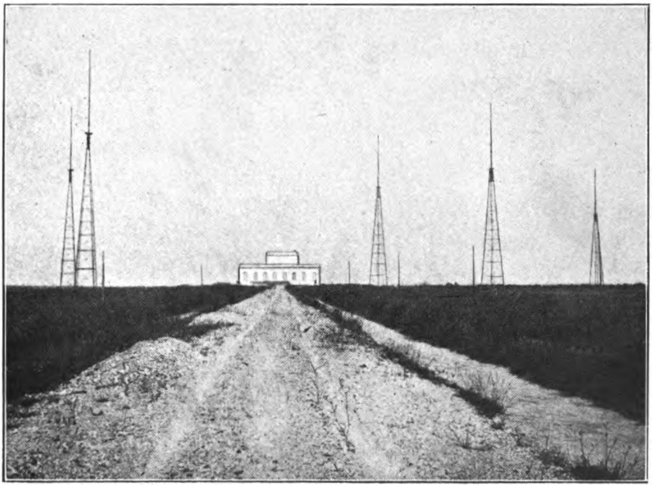


Fig. 16.

The secondary inductance "S" and "s" is similar in construction and function to the above.

The transformer or jigger consists in the water case of the two heavy pistons "P" and "S" joined by the spring "M," and in the electrical case of the two coils "p" and "s" joined by their common magnetic field "m." When the piston "P" moves it compresses or extends the spring "M," which tends to move the piston "S." Similarly, when a current flows in the coil "p," it creates a magnetic field "m" which tends to produce a current in "s."

The aerial consists in the water case of a long elastic bulb



Distant View of the Aerials of the High Power Station at Coltano.

[*To face page* 348

" A," and in the electrical case of an elevated wire " a." When water flows into the bulb " A " it expands, producing a pressure tending to cause the water to rush out again. Similarly, when a current flows into the aerial *" a,"* it becomes charged, producing a voltage tending to discharge it again.

The earth consists in the water case of a reservoir " E," and in the electrical case of the earth " e." The water flowing in and out of the bulb " A " is taken from or given to the reservoir " E," just as the current flowing in and out of the aerial *" a "* is taken from or given to the earth " e."

Primary Circuit.—The propeller " G " produces a pressure tending to move the water which, being unable to pass the valve " D," moves the piston " P " and deflects the diaphragm " C." The more the diaphragm " C " is deflected the greater becomes the difference of pressure between the water on the two sides, until at last it is sufficient to force the valve " D " open. When the valve " D " is open the water rushes through, allowing the diaphragm " C " to return to its normal position; but this rush of water has set the piston " P " in motion, and, owing to its inertia, it does not stop at its normal position, but passes it, pushing the water through the valve " D " and deflecting the diaphragm " C " in the opposite direction. Now the diaphragm " C " returns again to its normal position, setting the piston " P " in motion in the opposite direction, which in turn deflects the diaphragm " C " in the same direction as before. Everything is then exactly where it was when first the valve " D " was forced open, and this cycle of operations is therefore repeated again and again, causing an alternating flow of water and an oscillation of the piston " P." But, owing partly to friction in the pipes and mainly to the energy transmitted through the spring " M " to the other circuit (as will be further explained later), each oscillation is smaller than the previous one, and as soon as the water has become comparatively still the valve " D " falls back into its seat and sticks there until the propeller " G " again produces sufficient pressure to force it open.

Similarly the generator " g " produces a voltage tending to cause a current which, as it cannot pass the spark gap " d," charges up the condenser " c " and creates a magnetic field at " p." When the voltage becomes sufficient a spark jumps across the gap " d " and this path becomes conductive. When the spark gap " d " becomes conductive the condenser discharges

through it, but the inductance at " p " causes the condenser " c " to charge up again in the opposite direction. Now the condenser " c " again discharges through the spark gap " d," causing a current to flow in the opposite direction through the inductance " p," which, in turn, charges up the condenser " c " in the same direction as before. Everything is then exactly as it was when the spark first occurred, and this cycle of operations is therefore repeated again and again, causing an alternating current and an oscillation of the magnetic field at " p." But, owing partly to the resistance of the circuit and mainly to the energy transmitted to the other circuit, each oscillation is smaller than the previous one, and as soon as the current has become comparatively small the spark gap " d " ceases to be conductive until the generator " g " again produces sufficient voltage to break it down.

The most important point to consider is the frequency of the oscillations. It is obvious that the more elastic the diaphragm " C "—the more easily it bends—the less forcibly will it set the water in motion. It is equally obvious that the greater the inertia of the piston " P " the less easily will it be set in motion. Hence increase of the elasticity of " C " or increase of the mass of " P " decreases the frequency of the oscillations of the water. Similarly, in the electrical case increase of the capacity " c," or of the inductance " p," decreases the natural frequency of the oscillating current in that circuit, or, in other words, increases the natural time period and wave length, the latter being actually proportional to the square root of the product of the capacity and the inductance.

Aerial Circuit.—If the piston " S " be moved along so as to cause a pressure in the elastic bulb "A," and if the piston " S " be then released, it is obvious from the foregoing that an oscillation will take place, the extra water being taken from or given to the reservoir " E." It is equally obvious that the frequency of the oscillations will depend upon the elasticity of the bulb " A " and the mass of the piston " S." Now, however, we encounter a new phenomenon. In the primary circuit the whole of the water was confined within pipes which were almost, if not quite, rigid, but in this aerial circuit we have an expanding and contracting bulb which affects the air around it. If the oscillations are sufficiently rapid a musical sound will be produced by the bulb, and conveyed by the air to a distant receiver such as the ear. The damping or dying down of the oscillations in this circuit, there-

fore, depends partly upon the friction in the pipes, but mainly upon the energy radiated or carried away by the surrounding air.

Similarly in the electrical case if the aerial "*a*" can be charged and left to itself, it will oscillate (taking its charge from the earth "e"), with a natural frequency depending upon the capacity of "*a*" and the inductance of "s," and the oscillations will rapidly die down owing to the energy radiated or carried away by the surrounding ether.

Coupling and Tuning.—The primary circuit with small internal losses and consequent persistent oscillations, and the aerial circuit with large radiation and consequent high damping, have so far been separately treated, and the effect of the one upon the other must now be considered. If the pistons "P" and "S" are coupled together by the spring "M," the oscillations of the piston "P" will tend to produce similar oscillations of the piston "S." If the natural frequencies of the two circuits are the same, the piston "S" will oscillate freely, but if the natural frequencies are different the piston "S" will scarcely oscillate at all. The reason for this is not far to seek. If the natural frequencies are the same, each impulse given by the piston "P" to the piston "S" will coincide with its natural movement, and therefore increase its swing until the energy radiated from the bulb "A" equals the energy supplied from the piston "P." If, on the other hand (to take an extreme case), the frequency of the primary circuit is double the frequency of the secondary circuit, then the first impulse given by the piston "P" to the piston "S" causes it to oscillate, but just as it is on its return stroke the second impulse comes, stopping it and destroying the work done by the first impulse.

In the electrical case, if the aerial inductance "s" is put so close to the primary inductance "p" as to be within its magnetic field, the oscillations in "p" will tend to produce similar oscillations in "s." If the natural frequencies of the two circuits are the same, the aërial circuit will oscillate freely, but if they are different the aerial circuit will scarcely oscillate at all. The process of making the natural frequencies of the two circuits the same consists of adjusting the inductance or capacity of either circuit until their product is the same as the product of the inductance and capacity of the other circuit. This process is called tuning.

SYNTONY

THE word "Syntonisation" was first employed in connection with the observed phenomenon that when a tightly-stretched string—on a violin, for instance—was made to give out a note it would cause a neighbouring string to vibrate and sound, provided that that string were tuned to the same note. The two strings were then said to be syntonised or in resonance.

The phenomenon is, of course, a common one in acoustics; but to limit the term to a use in connection only with sound-waves would be to deprive it of all but a small fraction of its true scope and significance, for syntony and resonance, using the terms in their fuller sense, are met with in many and varied connections.

The formula giving the time-period (on which, of course, the note depends) of such a stretched string—namely

$$t = 2l\sqrt{m/T}$$

where l is the length of string, T the stretching force, and m the mass of unit length—is closely connected with the equally well-known formula for the time-period of a simple pendulum, which is

$$t = 2 \quad \sqrt{l/g}$$

where l is the length of the pendulum and g is the acceleration due to gravity, which provides the restoring force. Both are, in fact, particular cases of the general law for simple harmonic motion—namely,

$$t = 2\pi\sqrt{I/k}$$

where I is the moment of inertia and k is the ratio (Force required to produce displacement $\theta)/\theta$.

So that just as one string can be made to set another into vibration if the time-periods of the two are the same, and just as one pendulum can be made to drive another if the periods of swing are equal, so also may we expect to obtain resonance in any case to which the general law can be applied.

We find numberless examples of syntonisation in the science of light. The formation of the spectrum by prisms, the wonderful phenomenon of the rainbow, the colours of everything we see—all these are effects of resonance. When white light passes through a glass prism, it enters as a mingled ray of all colours—an irregular wave composed of a Fourier's series of regular waves. On entering the glass, the constituent waves find there systems of

electrons vibrating with every kind of time-period—so great a variety that every wave of the series can find some suited to it. So in the prism the many constituent waves of the white light transfer their energy to the different electrons—each wave choosing those electrons which are in resonance with it—and the mixed wave is sorted out in the glass into vibrating systems of electrons having the various periods of the constituent waves. These electrons pass on the energy with a speed depending on the time-period, the shorter the time-period the slower being the process of passing-on, and the greater the deviation caused by the prism.

Again, if we look at a piece of gold, the yellow colour we notice is due to resonance, for it means that certain of the mixed waves of white light have found, on coming against the metal, certain systems of electrons syntonised to them; these waves therefore have given up their energy to the electrons, and the light is reflected back to the eye deprived of these particular waves.

If the gold is beaten out into a thin sheet, the phenomenon of resonance is shown even more clearly, for the resonant electrons which received the energy from the absorbed waves give some of it out on the other side; so that the fine gold leaf appears green when seen by transmitted light.

We see, therefore, that syntony is a phenomenon entering widely into the processes of Nature. So far as electrical science is concerned, it was known to exist since the early days of alternators and alternating current; its effects in this direction being so marked as to prove disastrous unless properly provided against. The accidental production of resonance in alternating circuits has often led to the formation of voltages and currents of magnitudes far exceeding those expected and provided for, and it is only of recent years—since the introduction of Wireless Telegraphy—that electrical syntonisation has ever been considered an effect to be sought after.

And yet the syntony which plays so important a part in Marconi telegraphy is just the same in nature as the resonance in low-frequency circuits which used to cause so much damage in cables and plant and temper in the old days. It is simply the adjustment of the values of capacity, inductance, and periodicity until they conform with a certain equation.

At this point we may do well to notice a slight differentiation

between the words syntony and resonance which is generally observed. If we take an alternating or an oscillating circuit and adjust the values of capacity and inductance to suit the frequency of the voltage which is being applied to it, we may be said to be bringing the circuit into resonance.

If we then take a second circuit which can be acted on by the first, and arrange the values of this circuit so that it has the same time-period as the first, then we are said to be syntonising the second circuit to the first. Obviously, when this is the case, the second circuit will be in resonance with the frequency of the first. Two circuits, therefore, are said to be *syntonised* when they are *in resonance* with the same frequency.

The root of the matter in electrical syntony lies, of course, in the fulfilment of the well-known condition $Lp = 1/Cp$, p being $2\pi n$ where n is the number of complete waves per second.

This applies not only to high-frequency syntonisation used in wireless, but also to the low-frequency resonance which is also made use of, and which, so far from acting as a bane, as it so often does in low-frequency circuits, has been of the utmost use in enabling large powers to be used for spark-production without the danger of arc-production, into which large-power sparks are liable to degenerate.

But this kind of syntonisation, in the generator circuits, does not come within the scope of this paper, in which we shall confine ourselves to the high-frequency syntonisation of the true "wireless" circuits. Here, the equation for the time-period is

$$t = 2\pi \frac{2LC}{\sqrt{4LC - R^2C^2}}$$

In books on Wireless Telegraphy one sometimes meets with remarks which suggest that syntony is a comparatively recent improvement in that process.

As a matter of fact, syntonisation in some form or other has played a part in the earliest experiments with electric waves, even in times before or contemporaneous with Hertz. Sir Oliver Lodge, in his first experiments with Leyden jars, in which a spark in a circuit containing the first jar induced a spark in a circuit containing another jar, found that the second circuit had to be adjusted properly before the effect was obtained. In other words, he had to syntonise the two circuits. The original Marconi "plain aerial," often spoken of as the "whip-crack" transmitter, and

generally regarded as the prime example of a non-syntonised arrangement, nevertheless had a definite frequency of its own and a distinct, though short, wave-train. Dr. G. W. Pierce has photographed the spark of such an aerial and has found that there are about twelve waves in the train. By "waves" he probably means, in this connection, half-waves, so that the plain-aerial wave-train may be taken as containing about six complete waves. Evidently, to make the fullest use of such a train, syntony is necessary, and, as a matter of fact, the very simplicity of the original Marconi transmitter and receiver, and the similarity of one experimental station to the other, ensured that even in the preliminary work syntonisation was obtained to a certain extent. Indeed, Mr. Marconi, in his very first patent, includes a method of varying the natural period of the receiving apparatus so as to give the best results.

Sir Oliver Lodge, from the very beginning, laid special emphasis on syntonisation, and his transmitting and receiving "capacity areas" included in their circuits a syntonising coil for varying the period. The first Lodge transmitter, although to all intents and purposes it was still a "plain aerial," sent out a longer train of waves owing to the larger energy-storing capacity of the coil and conical vanes; and therefore resonance was more marked than with the simple vertical wire of Marconi.

The next step—a most important one—in the direction of more marked syntonisation was when Marconi introduced the coupled and tuned transmitter—a combination of a closed circuit of great energy-storing capacity with an open aerial circuit of great radiating power, the two circuits being carefully syntonised. The longer trains of waves produced by this arrangement enabled the selective powers of the coupled receiver circuits (already introduced) to display themselves to much greater advantage than they could when the only wave-trains at their disposal were the short ones of the plain-aerial type. Up to that time the coupled-circuit receiver—that is, a receiver circuit in which the aerial was connected to the primary, and the receiver to the secondary, of an air-core transformer or "jigger"—had been useful in strengthening the received signals, not so much by taking advantage of resonance as by removing the high-resistance receiver from the aerial circuit and placing it at a point where the potential-value, instead of the current-value, of the received signals was at its highest. Nevertheless, even with signals from a plain-aerial

transmitter, syntonisation of primary and secondary was necessary, and Marconi paid particular attention to it in the design of his "jiggers." When, shortly afterwards, he introduced the coupled-circuit transmitter just referred to, the advantages of good reasonance became still more obvious, and by the use of a "transmitting jigger" at one end and a "receiving jigger" at the other he was enabled to accomplish far greater distances than before. Moreover, syntonisation was sufficiently good to enable him to give a beautiful demonstration of duplex transmission and reception, two messages being transmitted simultaneously from the same aerial and received on one receiving aerial, from which they were separated out by syntonisation and recorded on two separate receivers. Also—and this is of even greater importance—it was shown to be sufficiently good to permit small-power ship stations to work without interruption in the neighbourhood of powerful land-stations sending out waves to travel thousands of miles. Were it not for this fact, the establishment of such long-distance stations would probably have to be foregone, for fear of disturbing all the ship-communication within range.

Here, then, we come into contact with one of the chief uses of syntonisation—the prevention of interference by other stations. The coupled-circuit transmitter had a beneficent effect in two directions: in the first—and this was the more important so far as extending the range of transmission is concerned—it enabled more power to be applied to transmission without increasing the length of the spark-gap in the aerial circuit; and in the second it gave a far more undamped wave—and therefore a longer wave-train—which enabled considerable selectivity to be attained. In each of these two directions syntonisation plays an important part; for in order to make efficient use of the greater power applied careful syntonisation of the primary to the secondary circuit of the transmitter is essential, and in order to obtain selectivity equally careful syntonisation of the transmitting to the receiving circuits is necessary.

We now come to the question: In what way, and to what extent, does syntonisation contribute towards selectivity? We may consider the question in the following manner. Taking a simple oscillating circuit, consisting of a capacity in series with an inductance, as our transmitter, and supposing it to be set oscillating in some manner so that it sends out undamped waves of a fixed wave-length, we may take for our receiver a similar circuit, with, however, a variable inductance or condenser—let us

suppose that it is the condenser which is variable. By changing the value of this condenser, then, we can alter the time-period of the "receiver" within a certain range in the neighbourhood of the time-period of the "transmitter." Let us call the value of the condenser at which the time-period of the receiver is equal to that of the transmitter, C_r (standing for "capacity for resonance"), and the values of the condenser gradually descending below this point C_{r-1}, C_{r-2}, C_{r-3}, etc., and the values gradually above this point C_{r+1}, C_{r+2}, C_{r+3}, etc.

Further, let us suppose that we have some means of measuring the value of the current produced in the receiver by the waves emitted by the transmitter. Everything else being kept constant, the receiver can be thrown in or out of resonance with the transmitted waves by altering the variable condenser, and the currents produced under these varied conditions of syntony be measured and denoted by i_r, i_{r-1}, i_{r-2} . . . and i_{r+1}, i_{r+2}, etc., corresponding to the value of the condenser.

We know, from the general idea of the meaning of syntony, that of all these i_r will be the greatest, and that i_{r-1}, i_{r-2} . . . and i_{r+1}, i_{r+2} . . . will form descending series on either side.

If we plot a curve with rectangular co-ordinates, making the ordinates represent the values of i and the abscissæ the values of C, we get a more or less symmetrical curve showing a maximum ordinate i_r. This ordinate, then, represents the amount of current available for indicating the signals when the receiver is properly syntonised to the transmitter. With the condenser at a value C_{r-2}, say, the receiver will be syntonised to another station with a wave corresponding to the new time-period of the receiver, and the original transmitter may now be considered as a "jamming" station, whose waves threaten to interfere with the working of the two syntonised stations.

The strength of such interference is clearly measurable by the ordinate i_{r-2}; so that it is obvious that the selectivity of such an arrangement depends on the shape of the curve. The question now arises: On what does the shape of the curve depend?

We have assumed that the transmitter is sending out undamped oscillations; it is clear that any effects of syntony and a-syntony in the receiver must depend on the production of oscillating currents therein. We also know that oscillations are impossible in a circuit in which the resistance is greater than a certain value depending on the capacity and inductance of the

circuit; for in the equation for the time-period of an oscillating circuit, given on p. 354, if R^2 is greater than $4L/C$, the expression under the root becomes negative and the value becomes unreal. It follows, therefore, that if we introduce sufficient resistance into the "receiver" we shall prevent the setting-up of oscillations and resonance, so that the curve of current produced by the transmitter would become a straight line parallel to the horizontal axis and (since the effect produced would be very small) very near to it. So we see that we can change the shape of the curve from a straight line to a maximum-showing curve by reducing the resistance in the receiving circuit; and we might expect to be able, by reducing it still further, to obtain a curve still more unlike a straight line—in other words, a more "peaked" curve. This is actually the case, and by altering the resistance we can get a complete series of curves showing better and better defined maxima as the resistance is decreased. It is clear, from what has just been said, that the more "peaked" the curve the better is the receiving circuit from the point of view of selectivity, so that the great thing to be aimed at, apparently, should be to keep the resistance low.

In many books on radiotelegraphy it is said that sharp syntonisation is prevented in the receiving circuits by the fact that a high resistance has of necessity to be introduced, in the form of a detector of some kind. This statement, as it stands, is somewhat misleading, for one's thoughts immediately turn to the Marconi magnetic detector, the resistance of which is very small. One might, therefore, expect to get enormously better syntonisation with the use of this than by using other detectors, such as the Valve or Crystal, which have very high resistances. But the fact is that the effect of the added resistance, in "flattening" the curves as described above, is not so much the effect of resistance *per se* as of absorption of energy (in this case in the form of heat) from the oscillations set up; and as every detector, in order to fulfil its functions, must absorb energy, the flattening of the curves is an effect common to every detector, whatever its resistance may be. The moral of this is that the losses in the receiver circuits should be kept down as much as possible except in those places where they are useful, and contribute to the production of the signals. For this reason the Marconi Company uses in its receiving circuits, when exalted syntonisation is required, wires consisting of many strands of separately insulated copper wires.

We have seen that the selectivity of the receiving circuit depends on the shape of the curve plotted, as described above. Now this curve goes hand-in-hand with, and is an index of, the decrement of the oscillations set up in the circuit—it is a measure of the rate of decay of the wave-train produced therein by the incoming waves. So we may say that the selectivity of the arrangement depends on the decrement of the oscillations produced in the receiving circuit. In the case we considered above we assumed that the incoming waves were undamped—that they had in themselves no inclination to decrease and die out; all the decay, therefore, which is indicated by the gradual slope of the curve is in this case due only to the loss of energy in the circuit of the receiver, and if this could be reduced to zero (which, of course, is impossible in practice) the curve would lose all signs of "flatness" and mount up suddenly to the maximum of perfect syntony.

If, on the other hand, the waves sent out from the transmitter are not undamped, but have a decrement of their own, then the curve represents the combined effects of this damping and the damping in the receiving circuit; it represents, in fact, the sum of the two. Hence if one of the curves previously considered represents δ_1 the decrement of the receiving circuit of a particular arrangement, and we now change the transmitter so that it sends out waves of decrement δ_2 instead of undamped waves, then the curve would take a new form, so that it represented the decrement $\delta_1+\delta_2$.

Now in the case of the old-fashioned transmitter, where the spark-gap was in the aerial circuit, the value δ_2 of the decrement of the transmitted wave was high in comparison with δ_1, the decrement of the receiving circuit; Dr. W. H. Eccles puts it at three times the value of this latter. It is clear, then, that the change in the "peakiness" of the curve to allow for the addition of this large decrement would be considerable, so that with a "plain aerial" wave-train the curve would be very much flattened, and refined syntony could not be obtained. With the introduction, however, of the coupled-circuit transmitter, the rate of decay of the transmitted waves was enormously decreased, so that even with the original fixed-gap discharger the value of δ is small compared with δ_1, and the shape of the curve at the receiver is governed chiefly by the absorption of energy at the latter. In the words of Professor Pierce, "the main imperfec-

tions of tuning are due to the resistance" (*i.e.*, energy losses) "of the receiving station, and not to the lack of purity of the wave from the sending station."

It is clear, however, that if the decrement of the transmitted wave can be reduced still further without counteracting disadvantages in other respects, a certain amount of advantage will be gained in the direction of sharper syntonisation, though not nearly so much as we should expect to gain if we forget the fact that the dominant factor in the case is the damping of the receiver.

Although the first great step in this direction was taken when the transmitting spark-gap was made short and of low resistance by placing it in the primary circuit of the coupled-circuit transmitter, in connection with a condenser of very large capacity compared with the aerial capacity, nevertheless many methods remain by which the damping of the wave-train sent out can be reduced. Unluckily, most of these methods do not conform with the condition just mentioned: that they should not be attended by counteracting disadvantages. One—used almost universally, and with good results—is to loosen the coupling between the primary and secondary circuits of the transmitter; this can be done up to a certain point with advantage to the nature of the waves, and without disadvantages as to their amplitude or "strength"; but if carried beyond this point, it results in a serious loss in amplitude and consequent effect on the receiver.

Other methods, more radical in their differences, result in the formation of waves of constant amplitude, but of irregular shape (*i.e.*, not true sine-waves), which give excellent syntonisation; but these methods are handicapped by the fact that great practical difficulties are found in getting this constant amplitude to anything like the large values such as are obtained by the spark methods.

One method—a modification of the old spark method—has been found which has no counteracting disadvantages beyond the requirement of a small amount of extra power. Before discussing this method it is necessary to consider a factor, hitherto not mentioned, influencing the damping of the wave sent out by a coupled-circuit transmitter.

The damping of the emitted wave is, of course, controlled by the rate at which energy is supplied to the aerial from the primary, combined with the decrement of the aerial itself; a

decrement due chiefly to its radiating powers, but also to any resistance-losses which may occur in it. The first step to take for the production of wave-trains of low damping is, therefore, to provide an aerial with a low damping. This means that the aerial wire must be given a surface sufficiently large to prevent all heating effects from the oscillations put into it, that all parts of the aerial circuit—such as tuning inductances and jigger secondary—must be equally well designed, that the insulation of the whole system must be good, and, above all, that the resistance of the "earth" must be small, so that the joulean losses in the earth near the aerial may be as low as possible. In this direction much importance attaches to the suitable design of the "earth" system.

But this is only one factor in the determination of the damping of the emitted wave. We have seen that in the case of the receiver the selectivity depends on the "peakiness" of the tuning-curve, and that this, in its turn, depends on the intrinsic decrement of the receiving circuit, combined with the decrement of the incoming waves.

So also the decrement of the waves out-going from the transmitting aerial depends on the intrinsic decrement of that aerial, combined with the decrement of the oscillations which produce those waves in the aerial—namely, the primary oscillations produced by the spark. Considered as a separate circuit, the primary circuit, with its short spark-gap (short compared with the "plain aerial" gap), and its carefully designed broad copper leads, can be made to have a small resistance-decrement, just as the receiving circuit can be. But, also like the receiver, its decrement is utterly changed when it is working as a transmitter, from the fact that it is constantly allowing itself to be robbed by the secondary and aerial, in order to perform its functions as a transmitter. The result, then, is that the primary oscillations, within a very short time, have given up all their energy to the aerial, especially if the coupling is tight; and the primary circuit would then be lying idle, but harmless, if it were not for the fact that the aerial—which, though a good "radiator," is not linked nearly so tightly to the external ether as it is to the primary circuit—immediately starts giving back some of its energy to the primary. This action and counteraction repeats itself until all the energy in the original wave-train has been spent, a part usefully in radiation, the rest uselessly in the form of heat, etc.

The result of this inter-action between primary and secondary is to produce two (and sometimes three) different frequencies in the aerial, which has the effect, therefore, of sending out either two waves of different length at the same time (which is the case if the coupling is tight), or one wave which seems undecided as to its proper wave-length (which is the case if the coupling is fairly loose). Both of these conditions are, of course, detrimental to good syntonisation at the receiver, for if the incoming wave-train is going to behave as if it were syntonised to C_{r-1} and C_{r+1} as well as to C_r (see p. 357), it is obviously going to give trouble to "cut out" when signals from other stations are being received. But quite apart from these altruistic objections to such a condition, the transmitted wave is itself placed at a disadvantage by being thus ill-defined; for it cannot take advantage of the full maximum of resonance represented by C_r.

This defect can be, to some extent, remedied by two simple methods: the coupling of the transmitter can be tightened, with the result that two waves are sent out entirely different in length, so that the one does not interfere with the careful syntonisation of the receiver to the other; or it can be loosened to such an extent that the aerial gets rid of its energy to the ether rather than return it to the primary, so that the inter-action is avoided and only one wave emitted. This alternative was mentioned on p. 360, and, as stated there, cannot be carried beyond a certain point without loss of efficiency. But apart from this question of efficiency, either of the above methods can be used to obtain the benefits of sharp syntonisation.

We now come to the method referred to on p. 360 as having no disadvantages beyond the expenditure of a small additional amount of power.

We have just now referred to the possibility of a third wave being found in the aerial. The formation of this wave may take place in the following manner:

After a certain amount of inter-action has taken place between primary and secondary, the amount of energy left in the circuits becomes insufficient to keep the spark-gap in the primary "broken-down." When this state is reached the aerial circuit is no longer coupled to a closed primary, and therefore radiates the remaining energy in the form of waves of its own intrinsic length.

We see, therefore, that a way of avoiding the inter-action is provided if we can arrange to break the primary circuit as

soon as it has transferred all its original energy to the secondary. If this is done, then the energy put into the secondary will radiate itself independently of the primary in the form of a wave of a single frequency. This is what happens when the Marconi Synchronous disc-discharger is employed in combination with a tight coupling; the spark commences when the electromotive force of the generator is just reaching its zero value and the condenser its condition of full charge, and the moment that the energy in in the primary circuit falls below a certain value, owing to its rapid transference to the secondary, the discharge across the rapidly opening and well-cooled gap is extinguished, and the aerial energy set free to oscillate and radiate with its own frequency.

There are various other methods of obtaining this result, such as the different systems of what is known as the "quenched spark"; but the great advantage of the synchronous disc is that there appears to be no limit to the amount of power that can be used efficiently with it, and therefore no limit to the distances over which a suitably designed disc-plant can carry. Moreover, increase of power does not bring with it any unforeseen practical difficulties, as is so often the case when an attempt is made to apply greater current and voltage to a system which has had its origin in experimental work with comparatively low powers.

Although the most important characteristic of the disc-discharger is its high efficiency between the primary circuit and the aerial, it comes within the scope of this paper as a factor in improved syntonisation; for although we have seen that the ordinary coupled-circuit with fixed spark-gap can be made to give good syntonic effects, yet to do this we must waste efficiency either by weakening the coupling very much—in which case a single wave of comparatively small amplitude is sent out—or by tightening the coupling so as to separate the two waves, in which case a certain amount of energy is lost in the wave neglected by the receiver; so that if, as is usually the case, the signals are required to be as strong as possible for a given output of energy, the inclination is to employ a coupling intermediate in effect, producing a wave less favourable to acute syntonisation.

Turning once more to the receiving end of a radiotelegraphic system, we find that syntonisation can be improved by weakening the coupling between the aerial circuit and the receiver. Here again, however, there is a loss of efficiency if the process is

carried too far, and a tight coupling usually gives the strongest signals. But if the coupling is made too tight, the inter-action of primary and secondary occurs here just as in the transmitting circuits, and the detector circuit, instead of giving up its energy usefully to the detector, returns some of it to the aerial.

It is clear, therefore, that the introduction of a means of varying, easily and gradually, the coupling between the receiving aerial and the detector circuit is a great help in syntonisation; and it is an almost universal practice in all well-designed receivers to have such a variable coupling. In the Marconi Multiple Tuner, for instance, not only is provision made for the rapid and accurate syntonisation of the aerial circuit and detector circuit to the incoming wave, but these two circuits are linked together by an intermediate circuit, also syntonised, whose coupling with the first two circuits can be readily varied.

In addition to the kind of syntonisation dealt with in the preceding pages, there is also another kind which, although of considerable importance and capable of giving excellent selectivity, is not in such general use. This is the syntonisation to note-frequency, as opposed to wave-frequency. If, by the introduction of large values of capacity or inductance, or otherwise, the actual *signalling* portion of the receiver (in most cases nowadays this is the telephone) be syntonised to a particular note, it will only respond freely to a transmitter which sends out wave-trains at such a rate as to produce that note.

Beautiful results on these lines have been obtained at the Chelmsford works of the Marconi Company and elsewhere.

But, as a rule, by syntonisation in radiotelegraphy is meant syntonisation to the wave-frequency; and in this respect it may be mentioned that Dr. W. H. Eccles, in a paper published in the *Electrician,* has shown that a suitably designed spark station can attain an efficiency as great as 92 per cent. of the ideal; that is to say, if the ratio of the energy received by the receiving aerial to the energy radiated out by the transmitting aerial be denoted by 100 in the case of the ideal and theoretical undamped wave, the same ratio in the case of an actual working spark system can approach as near as 92.

The s.s. "Nimrod," famous for her voyages to the Antarctic, was recently employed to take a party of engineers to the Kara Seas to erect Wireless Telegraph Stations on the Coast of North-Western Siberia.

[*To face page* 364

THE TECHNICAL SITUATION OF RADIOTELEPHONY

By J. Erskine-Murray, D.Sc.

DURING the past year or two a considerable amount of progress has been made in the development of wireless telephony stations. We still wait for the microphone which will control many kilowatts efficiently, and perhaps we may have long to wait in this particular line. This lack, however, need not seriously retard the extension of radiotelephony, for there are other ways, some of them already more advanced than the embryonic stage, by which a microphone of comparatively small current capacity may control a large output of radiation with the certainty which ensures good transmission of speech and, indeed, excellent articulation.

The first essential for telephonic transmission is, of course, a radiated current in which there are no interruptions whatever, or at least no blanks of greater duration than perhaps a fifty-thousandth of a second. In the latter case the speech may be intelligible, though there will be a considerable amount of extraneous noise; in the former the articulation at considerable distances is actually more perfect than the best so far obtainable in wire telephony. The reason for this advantage of wireless for long-distance transmission is not far to seek, and as it is an essential natural condition due to the method of transmission of the electric waves, which in both cases form the intervening carriers of the vibratory energy constituting the speech, the greater perfection of articulation in long-distance wireless telephony is likely to be a permanent argument in its favour.

In transmission of electric waves along a closed circuit, such as is used in wire telephony, there is invariably not only attenuation or weakness of the total sound, as the distance becomes greater, but also a decrease in the relative intensity of the upper harmonic waves which give the sound its particular vowel or consonantal character as compared with the intensity of the fundamental tone of the voice. Thus on a long-distance wire it is often possible to hear the voice comparatively loudly, while at the same time it is impossible to make out the words. This difficulty, which is a very serious one in transmission through submarine cable, has to some extent been remedied by attention to the sug-

gestions of Pupin and Heavyside, but is still one of the most serious drawbacks to wire telephony. The clear articulation of the speech transmitted by wireless telephony, on the other hand, does not suffer in anything like so great a degree by increase of distance. In fact, no appreciable loss of distinctness of articulation has been noticed in wireless transmission over four or five hundred miles of sea—a distance quite impossible at present for telephony through a submarine cable—and it seems certain that the same conditions will hold even at very much greater distances. The reason is that though long electrical waves do travel with somewhat less attenuation over great distances of land and sea than shorter ones, the variations constituting telephonic speech are all "long" waves from the wireless point of view. In wireless telephony, therefore, the difficulties lie not in the intermediate region between the transmitter and receiver, but simply in the transmitting station. The problem now in course of solution for long-distance radiotelephony is therefore simply that of causing the radiation of electrical power to vary in exact synchronism with the air pressure constituting the sound spoken into the transmitter.

For short distances, say, up to three hundred miles over land or sea, this problem has already been solved, and there are two distinct wireless methods, at least, by which telephonic communication may be established with certainty between any given points. One of these is that due to Dr. Poulsen, in which his arc is used as a generator of high-frequency current. In this system a group of microphones in series, and all contained in one mouthpiece, controls the antenna current either directly or by shunting a few turns of the main inductance. The theoretical conditions have been worked out by Professor Pedersen, and the application of his results in practice should lead to a marked increase in the efficiency of the microphonic control. Among other things which Dr. Pedersen has determined are the proper relations between the microphone and other resistances in the circuit to give the best conditions for transmission with various schemes of connections. As the actual measurements of high-frequency resistance and of the various efficiencies of a wireless station are now practicable, thanks to recent investigations, it is possible to apply Dr. Pedersen's theoretical work in actual practice, and hence to attain results with a certainty which bring radiotelephony into the sphere of ordinary engineering.

The use of the liquid microphone, which has been introduced into wireless working by Professor Majorana in Italy, has con-

tributed to the achievement of some remarkable distances of transmission. There are various forms of microphone, differing somewhat in principle and construction, in which a liquid is the chief agent in controlling the current. In Majorana's instrument, for instance, a fine stream flows from a jet which is attached to a diaphragm on which the voice impinges; lower down, the stream forms the connection between two electrodes in its path, and as the jet vibrates the varying thickness of the liquid film connecting them causes variations in the resistance of the circuit of which it forms a part, thus controlling the power radiated in the same manner as an ordinary microphone would do.

Another form of liquid microphone is that invented by Mr. F. J. Chambers. In this the diaphragm forms the upper covering of a box, inside which liquid flows from a central vertical pipe, the upper orifice of which is close to the diaphragm. An annular film of liquid is thus formed between the upper edge of the pipe and the diaphragm above it, the thickness, and consequently the electrical resistance, of which depends on the nearness of the diaphragm to the pipe. The vibrations of the diaphragm, when spoken to, thus vary the resistance of the liquid film, and as this forms part of the electric circuit of the transmitter the current is also varied in exact consonance.

Quite recently the invention of the Goldschmidt alternator has provided a new means for wireless telephony. With this machine it is sufficient to control the exciting current by means of one or more microphones, and as this exciting current is a direct current of low voltage equivalent to only about 4 per cent. of the total high-frequency power of the machine, the suitability of this system for telephony is obvious.

The present writer has frequently had the opportunity of listening to wireless telephony on this system, as well as on the Poulsen system, and in every case has been struck by the clearness of the articulation, even where in some experimental cases the volume of sound was comparatively small.

The greatest activity recently in radiotelephony has been in the United States and in Italy.

Dr. De Forest some years ago demonstrated the possibility of wireless telephony both in America and England, and a number of ships of the American Navy were fitted experimentally with his apparatus.

Demonstrations have also been given by Mr. Collins, who is

reported to use a high voltage system with carbon electrodes and a powerful magnetic field across the arc. A similar system, but with aluminium wire electrodes, which are kept in constant motion so that the base of the arc is always moving to fresh points of the electrodes, has been in use for some time in Germany and elsewhere, the inventor being Mr. E. Ruhmer. Mr. Dubillier has carried out some telephonic experiments in America with a shock excitation system resembling that of von Lepel.

In Italy M. Vanni is reported to have succeeded in establishing communication by wireless between Rome and Tripoli quite recently, though details are wanting as yet. Signor Jaciovello has also obtained good results.

The experiments of Professor Fessenden took place some years ago and were carried out by aid of a high-frequency dynamo. Speech was transmitted over wires to the wireless station, converted there into electrical radiation, relayed on to wires again at the wireless receiving station and transmitted to a further distance over wires. The outstanding importance of this demonstration lies in the fact that it indicates clearly the practicability of using a wireless section as a trunk line between exchanges. Its actual success was attested by several well-known experts in telephony, and though the distances were not great at the demonstration described, the possibility of intercommunication between wireless and wires was proved. More recently Professor Fessenden states that he has obtained telephonic communication between Brant Rock, Mass., and Washington, all also experimentally as far as Cuba.

The situation may therefore be summed up somewhat as follows:—There are several methods by which it is at once possible to establish radiotelephonic communication over a distance of a few hundred miles. In all these methods more power is required for telephony than telegraphy over any given distance, but the ratio is not so large as might be expected. This is owing to the much greater ease with which the ear distinguishes spoken words as opposed to mere signals. For one thing, the spoken word has no resemblance to atmospheric disturbances, and hence, as in ordinary wire telephones, a lot of extraneous noise is but little hindrance to the intelligibility of a conversation. The extreme smallness of the variations of current requisite to the transmission of speech over wires is well known, and in radiotelephony even less variation is required owing to the absence of distortion of the waves and the consequent clearer speech. Technically, there-

fore, wireless telephony is well advanced considering the short time it has been even theoretically possible. It has not yet, however, found its place commercially, and it is not yet quite clear from what quarter the first definite demand will come.

Since, however, these systems appear now to be on a somewhat firmer financial basis, we may expect that in the course of a year or two radiotelephony may take the place in systems of communication to which its technical qualities entitle it. Although time and experiment are still required for the installation of anything other than a simple station for direct communication, it appears certain that within a few years the use of radiotelephony for trunk lines over sea will be an accomplished fact, and that in other directions also great developments will have taken place.

[Dr. Erskine-Murray says in his paper that the wireless telephone has not yet found its place commercially, and that it is not quite clear from what quarter the first definite demand will come. This is perfectly true, and it is for this reason that the Marconi Company has up to the present made no attempt to develop, publicly, its inventions in telephony. It has, so far, concentrated its attentions to the development of wireless telegraphy, for which the world has an almost insatiable demand; but, at the same time, in its laboratories and workshops it has taken good care that the possibilities of the wireless telephone should not be neglected. Mr. Marconi's invention in 1907 of the high-speed smooth-disc discharger (see British Patent Specifications, G. Marconi, Nos. 8,462, 8,463, and 20,119, 1907) gave a key to the solution of the problem on thoroughly practical and commercial lines, suitable for long-distance communication; and on these lines various members of the Marconi staff have been developing the invention. It is not, very frequently, to the interest of a commercial company to publish, even in the form of Patent Specifications, all the latest inventions unless it knows that there is an immediate demand for them; consequently much of the work in this direction is of a confidential nature. But it may be mentioned that the Marconi Company has not limited its efforts to the evolution of powerful plant suitable for long-distance telephony, and recently a completely successful demonstration of a new portable telephone set was given at their works, the whole transmitting apparatus, apart from the mast and aerial, occupying less than two cubic feet.—Ed.]

THE DEVELOPMENT OF THE WIRELESS TELEGRAPH TRANSMITTER

By R. G. Kindersley.

IN the following article, which describes the process of evolution of the modern wireless transmitter from the piece of laboratory apparatus out of which it has been developed, an attempt has been made to show not only what changes have taken place, but also the causes which led to these changes.

The object of the transmitting apparatus of a wireless telegraph station is to radiate electric waves into space. The simplest form of radiator consists of two conducting rods of equal length, which are placed end to end, and between which a spark is made to take place. Such a radiator sends out waves into space, the wave-length of which is approximately equal to four times the length of one of the rods. If one of the rods is taken away and replaced by a conducting surface at right angles to the remaining rod, and a spark is made to take place between this rod and the conducting surface, it is found that electric waves are still given off, and that they have the same wave-length as before.

The first form of radiator used in wireless telegraphy was one of the first type mentioned above. With this form a distance of transmission of a few miles was obtained. It was the change to the second form of transmitter which constituted the great advance in wireless telegraphy and enabled much greater distances to be obtained. This form of transmitter was used a great deal in the early days and is still used in some cases. It is generally spoken of as the plain aerial system of transmission. In this system, a spark is made to take place between the lower end of a vertical wire and the earth. Waves are sent out into space by the vertical wire and radiated out in all directions, travelling, so to speak, on the surface of the earth.

If the aerial wire consists of a single straight wire, the wave-length of the wave sent out is approximately four times the length of the wire.

With this system, distances of 100 miles or more have been obtained when using a 10-in. spark induction coil supplied with current by accumulators. The actual length of the spark between

the aerial and the earth in these cases did not exceed two or three inches. When greater spark lengths were tried, with a view to increasing the range, considerable difficulty was encountered in connection with the insulation of the aerial, and it was found that the distance of communication was not much increased. This latter was principally owing to the greatly increased resistance of the spark.

As a result of this experience, transmitting systems were invented in which the spark was not made to pass directly between the aerial and the earth, but was made to pass across the discharger of a closed oscillating circuit, which was coupled inductively to the aerial circuit by means of a transformer, the primary of which was included in the closed oscillating circuit, and the secondary of which joined the aerial to the earth.

When this sytem of transmitting was first introduced, no special measures were apparently taken to make the closed oscillating circuit particularly suitable to the aerial with which it was to be used.

One of Mr. Marconi's most important patents covered the idea of tuning the closed oscillating circuit to the aerial circuit. That is to say, that a closed oscillating circuit was chosen of such dimensions that its natural frequency corresponded to the natural wave-length of the aerial system to which it was connected inductively. When such a system of transmission was adopted, it was found that the defects of the plain aerial system had been overcome. There was hardly any further trouble in connection with the insulation of the aerial, and owing to the fact that comparatively large condensers could be used in the closed circuit, it was no longer necessary to use very long sparks in order to put power into the system. This system worked well and, when used with a 10-in. spark induction coil, gave a distance of transmission up to about 150 miles. When attempts were made further to increase the distance of transmission, another factor was found to be limiting it. This was the contact-breaker of the induction coil, which was usually a platinum hammer break. Mercury breaks and electrolytic breaks were tried, but also gave trouble.

The next advance made in the transmitting apparatus was the application of alternating current to the production of the spark, thus doing away with the necessity of any contact breaker in the primary circuit of the induction coil.

Alternating currents were used both in conjunction with

induction coils and with transformers more closely resembling the ordinary commercial types. When alternating currents were first applied to this purpose, the results obtained were very varied. In some cases it seemed difficult to obtain anything but a very short spark, and in many cases, when that spark was obtained, it degenerated into an arc which burnt up the electrodes of the discharger, blew the fuses of the circuit, and gave no signals.

The next advance was made when it was recognised that in order to avoid the development of arcing, it was advisable to insert comparatively large choking coils between the spark-gap and the transformer secondary winding. These choking coils usually consisted of a large number of turns of comparatively small wire wound round a core of iron sheets or wires and very highly insulated from the core. When these choking coils were inserted it was found that the tendency to arcing was very much reduced, and, on the other hand, the conditions under which one could obtain a long spark seemed to depend on the amount of the inductance thus inserted and on the particular alternator which was used.

It was soon found that the frequency of the alternator was closely connected with the amount of inductance required in the circuit in order to get a good spark. From this it appeared that use was being made of the phenomenon of resonance, which may be briefly described as follows:—If an alternator is connected to a circuit having capacity and self-induction, and if the values of the capacity and the self-induction of the circuit have certain relations to the frequency of the alternator, it is found that the alternator sets the whole system in oscillation electrically, and that voltages are obtained across the terminals of the condenser very greatly in excess of the electromotive force of the alternator. This phenomenon has been met with on some long-distance power transmission lines, in which, in several instances, the insulation of the transmission cables broke down owing to this cause. Generally speaking, resonance had been thought of as a rather mysterious phenomenon met with in alternating current work, and a phenomenon which was apt to give rise to all sorts of unpleasant results. This idea was so deeply rooted that when Poldhu Station was first equipped various precautions were taken to prevent the appearance of resonance, and it was not recognised for some little time that resonance, when properly controlled, was of the greatest use in wireless telegraph transmitting systems.

The transmitting arrangements which were used at Poldhu were roughly as described above; that is to say, an alternator was connected to the primary of a transformer, the secondary of which was connected to a condenser through large choking coils. The condenser, which was charged by the transformer secondary, discharged itself through a spark-gap inserted in a closed oscillatory circuit comprising the condenser and the primary of a high-frequency transformer. The secondary winding of the high-frequency transformer was connected to the aerial and the earth. With these arrangements some trouble was experienced in connection with the insulation of the choking coils inserted between the transformer secondary and the condenser. Breakdowns constantly occurred between adjacent sections of these coils, and particularly between the turns which were nearest to the condenser. It was not a case of a breakdown to earth or a breakdown between the two choking coils, between which there was a big difference of potential. The breakdown sometimes actually occurred between two adjacent turns of one of the choking coils. This caused some surprise, as the transformer secondary current could not produce a difference of pressure of more than a volt or two between these turns. However, it was soon recognised that the effect was due to the high-frequency currents of the oscillatory circuit coming back into the choking coils, and that owing to the very high frequency of these currents there might be a very considerable difference of potential between adjacent sections of the choking coils. This difficulty was got over by inserting between the iron-cored choking coils and the condenser special protecting coils consisting of a single layer of wire with no iron core.

The transmitting system just described may be considered as a typical transmitting system with a fixed discharger. It has been very widely used and is still in use on most ship stations, the only modification being that the choking coils are usually inserted in the primary circuit of the transformer, and not in the secondary circuit. This arrangement reduces the difficulty of insulating the choking coils, and would probably have been introduced earlier if it had been fully recognised that choking coils in the primary circuit could be used for bringing the system into resonance with the frequency of the alternator.

With the development of large stations using long waves and large aerials, interference with reception owing to atmospheric disturbances became increasingly serious, and attention

was drawn to the necessity of taking measures to distinguish between the signals and the atmospheric discharges.

One of the first methods which presented itself was that of distinguishing the sounds produced in the telephone by the two causes. The sound in the telephone due to atmospheric discharges is generally a banging or rattling or grinding noise, which cannot easily be distinguished from the rattling sound produced in the telephone by a fixed spark-gap transmitter. If, however, the sparks are made to follow each other at the rate of several hundred in a second, they produce in the receiving telephone a musical note which can easily be distinguished from the noises due to atmospheric discharges, unless the latter are so loud as to drown the signals altogether.

Any attempt to get a musical note with an ordinary fixed discharger usually results in the complete failure of the signals owing to the formation of an arc. This is due to the fact that after a spark has passed it leaves in its trail a conducting path of incandescent, or at any rate very hot, air, which has not time to cool down or become dissipated in the short interval before the electrical pressure rises again for the production of the next spark. Consequently, there is a steady flow of electricity across the gap in the form of an arc.

The following method has been adopted for the avoidance of the formation of an arc:—

The spark is not allowed to pass directly between fixed electrodes. The electrodes are separated, and a toothed wheel is inserted between them and is rotated at a high speed. Every time that the teeth of the wheel pass the fixed electrodes a spark passes across the two air gaps from one fixed electrode to the toothed wheel and from the toothed wheel to the other fixed electrode.

The wheel ordinarily takes the form of a disc fitted with a number of studs projecting from it either radially or parallel with the shaft. The number of the studs and the speed of rotation are determined by the musical note which it is desired to obtain. The electrodes in the smaller dischargers take the form of rods which can be fed forward when required, to compensate for wear. In the larger dischargers the electrodes take the form of smooth discs which are rotated slowly so as to present a fresh surface to successive sparks and thus reduce the rate of burning away. The use of the disc discharger for the production of musical sparks prevents arcing owing to the fact that the movement of the studs

closes the air gap to a suitable distance, only at the moment when a spark is required to pass, and opens the gap again after the passage of the spark, thus rendering the gap non-conductive again.

The disc discharger was first applied to existing stations which had previously been working with fixed dischargers, and which were using alternating current of a comparatively low frequency—namely, 50 or 25 ∼

In such cases the disc was driven independently of the alternator which was supplying the current, and the spark frequency bore no relation to the alternator frequency. Poldhu was the first station to be fitted with a disc in this way, and remains a typical instance of such transmitters.

In the old transmitter at Poldhu the alternator supplies current at a frequency of 25 ∼ to transformers which raise the voltage to a value suitable for charging the condenser of the transmitter, to which they are connected through choking coils. A disc discharger with six studs is belt-driven by a motor at a speed of about 2,400 revolutions per minute, with the result that the studs pass the two electrodes 240 times in a second. The electrodes consist of smooth discs which are slowly rotated by small motors through worm gearing.

As the disc frequency is about ten times that of the alternator, the disc studs pass the fixed electrodes about five times in each half-period of the alternating current. The voltage available for successive sparks varies, owing to the variation of the alternator electro-motive force during the half-period. Consequently the musical note given by the spark is not a pure one, but is a combination of the alternator frequency and the spark frequency. It can be distinguished well from the noise of the atmospheric discharges, and the transmitter can be adjusted to work well. The chief troubles with this type of transmitter are caused by the fact that, unless the circuits are very well adjusted, there is a tendency to arcing, in which case the disc has to tear out the arc—a process which is liable to be accompanied by excessive rises in voltage and other undesirable effects.

When disc dischargers began to be applied to new stations they were arranged to be driven directly from the alternator shaft with a view to establishing a direct relation between the alternator frequency and the spark frequency, and so obtaining a more regular series of discharges. In some instances a twelve-stud

disc was direct driven from a four-pole alternator, thus giving a spark frequency six times the alternator frequency, or, in other words, giving three sparks per half-cycle. Such dischargers behaved in very much the same way as the non-synchronous dischargers. They gave a fairly good note when the circuits were well adjusted, but the adjustment was not very easy, and some difficulty was experienced in getting sparks on all the studs of the disc.

The best results were obtained when the number of studs on the disc were the same as the number of poles on the alternator, thus giving one spark in every half-cycle. Under these conditions use could be made of the fact that when an alternator is applied to an oscillatory circuit which is in resonance with the frequency of the alternator, the voltage across the condenser is always at a maximum when both the electromotive force of the alternator and the current in the charging circuit are at zero. From this it follows that if the discharger is so adjusted that the spark takes place at the moment when the condenser voltage is a maximum, there will be no tendency for the maintenance of an arc, as there is at that moment no electromotive force from the alternator. The spark-gap opens again before the alternator electromotive force has time to rise appreciably, so the arc does not strike.

From the above it will be understood that the time at which the spark takes place has to be accurately adjusted with reference to the time at which the alternator electromotive force passes through its zero value. This is effected either by arranging the coupling between the alternator and the disc in such a way that the disc can be set in different positions with reference to the alternator armature, or by mounting the electrodes on a rocker which can be set in the same way as the rocker which carries the brushes of a dynamo, or by mounting the stator of the alternator in such a way that it can be rotated and set in different positions with reference to the electrodes.

The construction of the synchronous discs is in all other respects practically identical with that of the non-synchronous discs described above. The rotation of the side electrodes is ordinarily effected by means of worm gearing connected to the main shaft.

The synchronous disc discharger works smoothly and well in every way and is now in general use. The adjustments are easy, the note is good, there is complete freedom from arcing, the effi-

ciency of the condenser charging circuits is high, the power factor is usually over 0·9, the manipulating key works particularly smoothly, a smaller bulk of condenser is required than with the non-synchronous dischargers, and all the results can be calculated beforehand with the greatest ease and certainty.

The synchronous discharger may be considered to represent a final stage in a course of development which has extended over a considerable number of years. Any further developments are likely to involve a distinct departure from the principles of action on which the Marconi transmitter is based.

A system of transmission involving the use of high-tension direct current must be mentioned here, not because it has been or is likely to be widely used, but because it has been applied to two important stations—namely, Clifden and Glace Bay. These stations are fitted with an accumulator battery giving about 14,000 volts. This battery is charged by high-tension direct current machines and is used in turn to charge the condenser of the transmitter, to which it is connected through choking coils. A disc discharger is used, and is very similar to those used on non-synchronous alternate current transmitters. The tendency to arcing is considerable, and necessitates the use of air blasts to help to extinguish the arc. The note given is exceptionally good, and the efficiency is very high. The manipulating keys do not work so easily as in the case of a synchronous transmitter—that is to say, the circuit is not broken so easily. But the principal reason why this type of transmitter has not been repeated is the cost and difficulty of upkeep of the direct-current dynamos and accumulator battery.

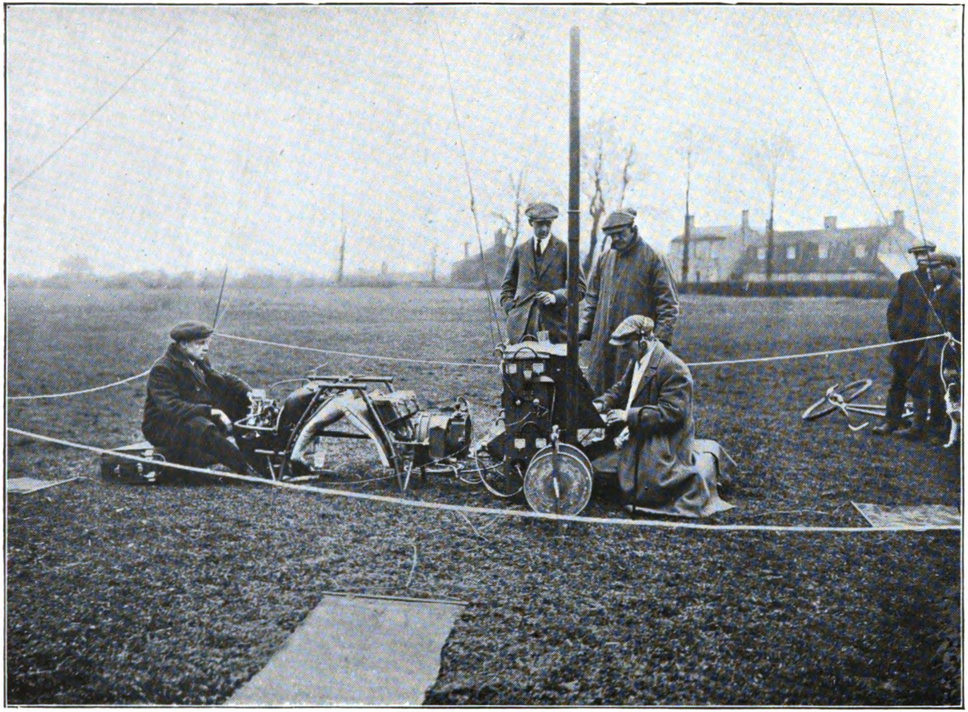
The choice of the musical note which is to be used in the transmitter depends on the requirements of the receiver. When telephones are tested with pure alternating currents of various frequencies it is found that the weakest currents can be heard when the frequency is about 900 per second, and the sensitiveness is found to be greatly reduced when the frequency is as low as 300 per second. But when various spark frequencies are used in a wireless transmitter, it is found that the signals in the receiving telephones are much weaker when the spark frequency is 900 than when it is 300 per second. This is probably due to the fact that the wireless notes contain harmonics, which add sharpness to the low notes, and which make the high notes less efficient than they would be otherwise.

WIRELESS TELEGRAPHY FOR MILITARY PURPOSES

BY MAJOR J. E. COCHRANE.

THE use of wireless telegraphy for military purposes became apparent as soon as the invention had been brought to a practical form by Mr. Marconi, and a certain number of more or less portable stations had been made for various armies. These were practically ship stations, complete, mounted in a cart, and were not in most cases specially designed for field service.

The first experiments with portable wireless telegraph stations with the idea of using them for military purposes were commenced in 1902. The stations were carried in a light van, and had a range of about eight miles. The antenna was supported by a number of bamboo masts, and the power for the transmitter was obtained from accumulator batteries. Two such stations were lent for trial to the War Office in 1903, but it was considered that no station having a range of less than twelve miles was of much use.. The increased range of twelve miles was obtained, but a still further range was demanded, until stations with a twenty-mile range were produced. In 1906, at the commencement of the Russo-Japanese War, similar apparatus was sent to Russia, where Marconi engineers demonstrated their working to the Russian Army officers. These stations were an improvement on those that were lent to the War Office for the original trials, inasmuch as the accumulator battery was replaced by a dynamo driven by a petrol engine. So successful were the trials with this apparatus that a



A Demonstration with a Pack Station.

[To face page 378

number of portable stations were immediately ordered, and were used during the war in Manchuria. This was the first occasion when wireless telegraphy had been used by an army under war conditions. The stations, however, were only for wheel transport, and on several occasions it was found impossible to use them on this account. This pointed to the necessity of stations that could be carried on pack-horses, and after a long series of experiments the first Marconi cavalry station was designed. As far as the transmitter was concerned, it differed very little from the present type cavalry transmitter, except that it was not so convenient for use and required the protection of a tent in wet weather. The power was derived from a dynamo driven by a pedal gear, which latter was made to fold into a case for transport purposes. The receiver consisted of a magnetic detector, but in other respects the stations were similar to the present ones.

The stations were carried at first on only three horses, but, as the loads exceeded the regulation limit as specified by most of the armies of the world, the number was increased to four. Although the same type of saddle was used, the system of loading was not so perfect as at present, and, in spite of the fact that the stations could be erected in only ten minutes, it required about half an hour to pack them on horseback. The station had a range of only twenty to twenty-five miles, this restricted range being chiefly due to the limit of power which could be taken out of a pedal gear, and to the comparative insensitiveness of the magnetic detector compared with the valve or crystal receiver. More elaborate cart stations were designed, and a number were sold to Italy, some also to Siam, and these were rapidly developed until, in 1910, a range of nearly one hundred miles was obtained over flat country in Italy.

Stations of the same type were taken for demonstration purposes into Switzerland, where, considering the enormous difficulties in the country, both in respect of ether waves and transport, the station did extremely well, and communicated over the St. Gothard mountains from Andermatt to Lucerne, a distance of about 60 kilometres, the mountains in between being 13,000 feet high.

Further valuable experience was obtained while working these stations in the Swiss Alps, and a new cavalry field station was designed, the chief improvements being :—(1) The apparatus was made independent of any kind of protection; (2) the pedal gear was replaced by a petrol engine mounted on the saddle frame; (3) the

magnetic detector was replaced by a valve receiver; (4) the system of loading the horses was vastly improved.

Two of these stations were then taken for test on the Army manœuvres, where they proved to be reliable, mobile, and simple in operation. Demonstrations have been given practically all over Europe. The result of these demonstrations has been not only successful from a commercial point of view, but the valuable information of the working of field telegraph stations under service conditions has made it possible to carry out from time to time valuable modifications and improvements in Marconi apparatus.

For military purposes wireless telegraphy has four advantages over the older method of communication by wire, which makes its value in time of war almost incalculable. They are:—

(1) Communication cannot be cut by the enemy, and there is no wire to be inadvertently broken by friendly troops.

(2) In case of a movement to a flank the communicating stations can be quickly moved without any wire having to be taken up and relaid.

(3) Communication can be established between two points without the necessity of having to traverse the country between the two points.

(4) Communication can be established with a ship at sea.

Although the use of these installations would increase the efficiency of an army, it does not follow that they would entirely supersede the field telegraph and telephone. For instance, where a complicated system of communication is required over short distances and where it is a simple and easy matter to run any number of insulated wires, this method would probably be adopted. It is a mistake to try and compare a wireless installation with a field telegraph installation for the purpose of proving that one or the other system is the better to adopt. The two systems are radically different in their operation, and they must each be studied independently with a view of utilising the best system for the particular purpose in hand, and also in order to get the best results from a combination of the two systems. A study of only those factors which from a military point of view are probably the most important, and to show how these points are actually carried out in practice by describing the various types of installations manufactured for the purpose, will perhaps be of interest.

The points referred to are—range, mobility, selectiveness, and secrecy. Of these points range and mobility may be taken together, as the one is more or less directly affected by the other.

The range of a wireless station is chiefly governed by the average height of the antenna above the ground and by the power of the transmitter. Roughly speaking, the range varies directly as the height of the antenna and as the cube root of the power. In other words, if it is required to double the range of a station which is using a 2 horse-power engine and the average height of whose antenna is 25 feet, it can either be done by increasing the height of the antenna to 50 feet and keeping the power of the same, or by increasing the power to 8 horse-power and leaving the height of the antenna as it was originally.

At first sight, therefore, it would appear to be more profitable to use high masts in order to get a big range; and this would certainly be the case if the question of mobility and time taken to get the station into action were of no importance. In practice it is found that a mast 50 feet high takes nearly three times as long to erect as a mast 25 feet high, whereas an 8 horse-power engine will start up just as quickly as a 2 horse-power engine; also the weight of a 50-foot mast is about four times the weight of a 25-foot mast, whereas the weight of an 8 horse-power engine will only be about three times as much as that of a 2 horse-power engine.

Thus, where the time taken in getting the station into action is of extreme importance, it will be found to be more advantageous to keep the power of the station high and the height of the masts low.

The mobility of the station, however, is effected rather differently, because, although the total weight of the station must be kept low on account of the different methods of transport by which it may have to be carried, it is also necessary to be able to divide up the total weight into small enough units. For instance, although the regulation load for a horse is 160 lbs., a piece of apparatus weighing 160 lbs. would be extremely difficult to carry on horseback unless it could be divided into two loads of 80 lbs. each, which could be carried one on either side of the saddle.

Now, a mast even 70 or 100 feet high can be divided up into small sections, and could thus be adapted to almost any kind of transport; whereas it is quite out of the question to divide up the engine or the dynamo every time the station is to be moved.

For this reason, therefore, where extreme mobility is the most important point, the power should be kept sufficiently low so that any single unit does not weigh more than 60 or 80 lbs., and the height of the mast would have to be increased according to the maximum range that might be required.

2 B

A factor that has not been mentioned, which directly affects the range of a station, is the sensitiveness of the receiver; but, fortunately, the modern receiver—an instrument which is susceptible to the minutest of electrical disturbances, and can be adjusted to discriminate between different electrical disturbances of very slightly different characteristics—is extremely robust from a mechanical point of view, and will stand any amount of knocking about and rough handling. It is therefore possible to use, with practically all types of military stations, the most sensitive receiver obtainable.

One important difference between wire telegraphy and wireless telegraphy is that with the former the influence of the transmitter is limited to the wire along which the messages pass, whereas with the latter messages are radiated in all directions and its influence is only limited by the range of the station.

Therefore, unless we had some means of selection between different transmitters, it would be quite impossible for more than one pair of stations to work together at the same time if they were within each other's sphere of influence.

There are two methods by which selection can be made between different transmitters. One is by the difference in the sound produced in the receiver, which may be referred to as "selection by sound," and the other is by the difference in wave-length, which may be referred to as "selection by wave-length."

By arranging that the transmitters of different stations send out a different musical note several pairs of stations would be able to work at the same time and within range of one another without interfering with each other, for the telegraphist would be able to keep his attention fixed on any one particular note.

The disadvantage of using this method of selection only, however, is that if the signals from the particular station from which it is desired to receive were much weaker than those from another station working at the same time, the weak signals would be more or less drowned by the strong ones.

Also, in order that the telegraphist could keep his attention to a particular note while another note is going on without strain to his ears, it is necessary to have a considerable difference between the notes.

The number of stations that could work at the same time within range of another would, therefore, be very limited without some other method of selection.

It is advisable to mention here that this method of "selection

by sound " is never spoken about as " tuning," nor is the sound heard in the telephone spoken of as a " tune." It is referred to as the " note " of the transmitting station.

The distance from the crest of one wave to the crest of the next wave is called the " Wave-length." The speed of radiation through the ether is about 1,000,000,000 feet per second. From this it will be seen that if the electrical oscillations in the antenna that produce the wave are at the rate of 1,000,000,000 times per second, the length of the wave would be 1 foot. Or if the oscillations take place at the rate of 1,000,000 times per second, the length of the wave would be 1,000 feet, and so on.

The wave-lengths commonly used in wireless telegraphy vary from about 300 feet to about 30,000 feet, the only limits imposed being those laid down by international conventions, and those which arise from practical considerations.

There are certain factors which make it difficult to radiate a big power in a short wave-length, so that it will usually be found that the more powerful the station the longer the wave-length used. Also, a long wave-length is less liable than a short wave to absorption by mountains, forests, or any other obstacles which might be in the line of communication. Thus it will usually be found that stations communicating over land use a longer wave-length than stations communicating over sea.

One of the difficulties to be overcome in the reception of signals is the electrical disturbances in the atmosphere known as atmospherics. They produce, in the telephone ear-piece of the receiver, a noise which is liable to interfere with the reception of messages.

Not very much is yet known about their origin, but their effect has been carefully studied, as, especially in the early days of wireless telegraphy, a great deal of trouble was caused by them, and in many cases they completely drowned the signals of the wireless station with which it was intended to communicate.

There are many different kinds of atmospherics, which produce quite distinct noises in the receiver. They are quite independent of thunderstorms and very often they are worst when the sky is perfectly clear.

The chief difficulty in getting rid of atmospherics is that they are very much damped, so much so, in fact, that they can be compared to the phenomena in sound waves. The result is that no amount of syntonising will get rid of them to any appreciable extent, and they have to be dealt with in an entirely different way.

The strength of the atmospherics in the receiver is more or less proportionate to the height of the mast and the size of the antenna, and as the field stations are supplied with only low masts and comparatively small antenna, they are practically never troubled with atmospherics, although these troubles are sometimes encountered with field stations of other manufacture, simply on account of the size of the antenna which they employ.

In powerful stations, however, such as those used for communicating across the Atlantic, where the antenna is not only very high but also covers a large area, before a satisfactory method of dealing with the trouble was devised, atmospherics were frequently strong enough to suspend communication entirely for several hours at a time, sometimes even for several days.

A system, however, has been devised and patented by Marconi's Wireless Telegraph Company, Limited, whereby two receivers are connected in opposition to each other. One of the receivers is carefully tuned to the wave-length which it is desired to receive, and the other is adjusted to a slightly different wave-length.

Now, both of these receivers respond equally to the atmospherics, and being connected in opposition the atmospherics are thereby neutralised. The signals, however, are only received in the receiver which is syntonised to the correct wave-length, and are therefore not neutralised.

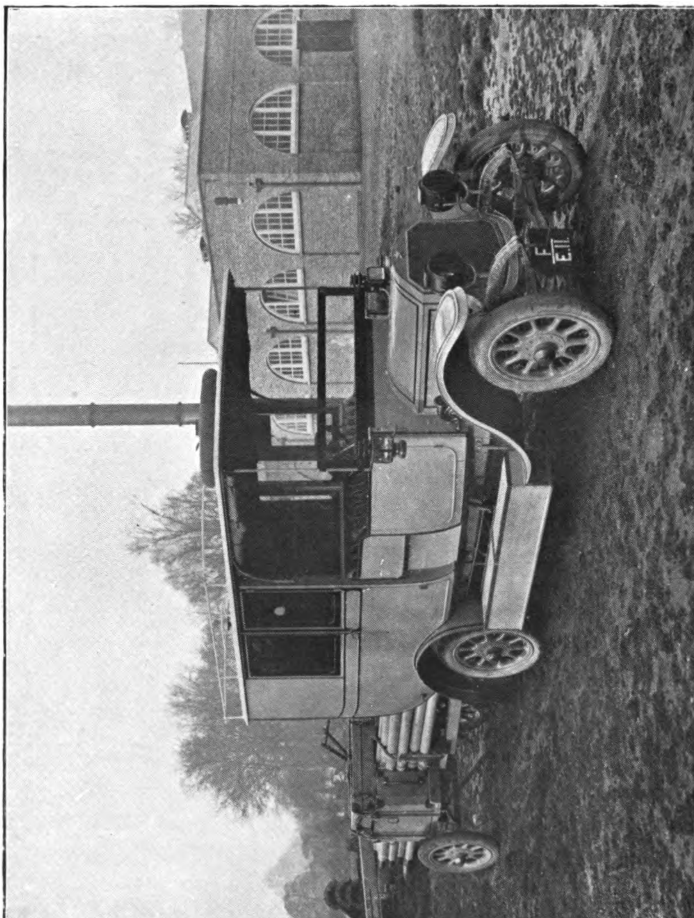
The apparatus for this is somewhat complicated, and, as already stated, is not necessary for stations using small antenna and low masts.

Secrecy, of course, is a point which requires careful consideration in the design of a military field station.

It is obviously only a matter of organisation to allow many stations using fairly flatly-tuned transmitters to work at the same time and within range of each other by allowing a margin of, say, 20 per cent. between their different wave-lengths, so that we can come to the conclusion that flatly-tuned transmitters lose nothing in the way of secrecy or selectivity over the sharply-tuned transmitters, and have the advantages of interfering with the communication of the enemy's stations.

Perhaps the surest method of obtaining secrecy has been adopted in the design of some of the Marconi field stations.

This method is to change the wave-length of the transmitter at frequent intervals from one fixed wave-length to another. In the ordinary way the time taken to change the wave-length of a



Motor-Car Wireless Telegraph Station.

[*To face page* 384

transmitter is a matter of some minutes, and to change the wave-length of the receiver a matter of some seconds. But in the stations above referred to the different components of the syntonised circuits of both the transmitter and the receiver are brought to a three-position switch, called the "change-tune" switch, one such switch being fitted to the transmitter and one to the receiver. Each position of the switch changes the wave-lengths to a definite value, and the switch being operated by a single handle, the time taken to change the wave-length of either the transmitter or the receiver is thus reduced to a fraction of a second.

The operator can therefore change his wave-length or "tune" after every three or four words to any of the three waves to which his switch has been adjusted without waste of time and by sending a code letter, indicating to which "tune" he was about to change before each change. The operator at the station with which he is communicating, and whose receiver is similarly fitted with a switch, would be able to follow him without difficulty, whereas any other station would only be able to read at the most a few disjointed words here and there, which would be of little or no value in the hands of an enemy.

Of course, if such a station were always to work on the same three waves the enemy's stations would soon measure the waves and devise a method of "standing-by" on all three waves; but the apparatus is so arranged that the value of each wave corresponding to the different positions of the change-tune switch can be varied to anything between wide limits, so that each day, or even several times a day, the values of the three wave-lengths can be themselves changed.

If the wireless service of an army were properly organised with such stations as these, it would be a practical impossibility for any station, not informed, to read the messages transmitted.

It is unnecessary to describe here the various types of portable apparatus that are available, for the tables of types of Marconi portable military stations shown on next page will enable a fair estimate to be formed of the character of this apparatus and the classes of work it will perform.

PORTABLE MILITARY STATIONS

(*See* pp. 378–385).

1	2	3	4	5	6	7	8	9
Type.	Description of Station.	Output of Generator in Kilowatts.	Guaranteed Range over flat Country.	Approx. maximum Range.	Normal time of erection in minutes.	Number of Horses or Mules required for transport.	Total Gross Weight of complete Station.	Height of Masts.
K	Knapsack	·04	6 miles 10 kms.	12 miles 20 kms.	6	By Hand	86 lbs. 39 kgs.	30 ft.† 9 m.
A	Pack	·5	30 miles 50 kms.	50 miles 80 kms.	10	4	804 lbs. 365 kgs.	30 ft. 9 m.
A1	Pack (Special)	·5	50 miles 85 kms.	80 miles 130 kms.	20	5	969 lbs. 431 kgs.	54 ft. 17 m.
C	Handcart	·5	30 miles 50 kms.	50 miles 80 kms.	10	1	1,157 lbs. 526 kgs.	30 ft. 9 m.
F	Cart	1·5	150 miles 250 kms.	250 miles 410 kms.	20	4 or 8	5,024 lbs. 2,284 kgs.	70 ft. 21 m.
H	Motor-Car	1·5	150 miles 250 kms.	250 miles 410 kms.	20	15-20 h.p. Motor	7,600 lbs.* 3,455 kgs.	70 ft. 21 m.
G	Semi-Portable	1·5‡	150 miles 250 kms.	250 miles 410 kms.	360	—	1,400 lbs. 600 kgs.	—§
L	Aeroplane	·04	6 miles 10 kms.	12 miles 20 kms.	—	—	50 lbs. 25 kgs.	—
L1	Aeroplane	·5	50 miles 85 kms.	80 miles 130 kms.	—	—	200 lbs. 90 kgs.	—
M	Dirigible	1·5	200 miles 335 kms.	300 miles 495 kms.	—	—	500 lbs. 225 kgs.	—
B	Cabinet	·5‖	75 miles 125 kms.	150 miles 250 kms.	—	—	350 lbs. 160 kgs.	—§
H1	Motor-Car	·5	85 miles 140 kms.	150 miles 250 kms.	20	20–25 h.p. Motor-Car	4,430 lbs. 2,013 kgs.	70 ft.
H2	Motor-Car	3	200 miles 335 kms.	300 miles 495 kms.	20	20–25 h.p. Motor-Car	7,800 lbs. 3,545 kgs.	70 ft.

* Including personnel. † One mast. ‡ If 70-ft. masts are used. ‖ If 50-ft. masts are used. § None supplied unless called for.

SOME FACTS AND THEORIES OF LONG DISTANCE SIGNALLING

By Dr. W. H. Eccles.

WHEN Mr. Marconi, in the first year of the twentieth century, announced his intention to attempt the transmission of wireless signals across the Atlantic, the thoughts of all students of electric radiation turned immediately to the difficulties offered by the humped mass of ocean, 125 miles high, that intervenes between the nearest coasts of England and Canada. This protuberance would have to be penetrated or circumvented; and the amount of bending implied in the latter alternative may be best appreciated by noticing that a ray of light starting from England in a horizontal direction would pass over the nearest point of Canada at a height of a thousand miles. Even if the earth were flat and not spherical the task was, for that day, a gigantic one, if only on account of the difficulty of radiating the amount of power demanded by the inverse square law. For, up to that time, the greatest distance and the greatest power expenditure were respectively of the order of 200 miles and 400 watts, and therefore a distance of 2,000 miles over a flat earth would require 40 kilowatts—an energy rate never before attempted with Hertzian wave apparatus.

But even if there had existed an obvious method of converting, say, 100 kw. into electric waves, the curvature of the earth which was actually at Marconi's disposal, taken with the above application of the inverse square law to the case of a flat earth, appeared to most thinkers to make the task impossible. The event of December 12th, 1901, when faint signals were propagated across 2,000 miles with a power of less than 15 kilowatts, showed that either the Flat-earthists are correct in their doctrines or that unknown electrical phenomena were assisting the propagation of the waves.

Since the date mentioned much greater distances have been spanned, especially at night; and though many of the long-distance feats on record belong to the category of "freaks," they

must be taken into account. But, apart from freaks, there is ample evidence that very great distances may be covered regularly. For example, during the early part of 1910 the Nauen station transmitted regularly in the night to a ship during the voyage from Hamburg to the Kameruns, a maximum distance of 3,400 English miles. But the record for regular long-distance signalling was set up by Marconi in September, 1910, when strong signals from Clifden, in Ireland, and from Glace Bay, on Cape Breton Island, were received in Buenos Aires during the night hours. The distance from Clifden to Buenos Aires is about 6,700 English miles, and the angle turned through by the waves in following the earth's surface is over 97°.

At distances of 1,000 miles or more a number of remarkable phenomena become prominent. The most striking fact is the effect of daylight on the strength of signals, an effect discovered by Marconi in 1902 during a voyage across the Atlantic. Signals from Poldhu which were readable at night up to a distance of 1,600 miles were not audible in daylight beyond 800 miles. These observations on the daylight effect on long-distance signals were not quantitative—great difficulties arise when the power of small oscillatory currents has to be measured—and thus we do not know even roughly how much weaker the signals are at 6,000 miles than at 1,000 miles or 100 miles. In fact, in the most recent attempt to determine the fundamental law of propagation over distances that bring in the curvature of the globe, that is, the law connecting distance and wave energy, the distances experimented over were only 1,000 nautical miles. These measurements were made by L. W. Austin, and were described in the *Marconigraph* of March, 1912. He measured the current in the receiving apparatus when various wave-lengths were used and various distances less than 1,000 nautical miles separated the communicating stations. The formula that fits the observations best shows that the ratio of the currents in the receiving and sending antennae is inversely proportional to

$$\lambda\ d \exp\ (ad/\sqrt{\lambda})$$

where d is the distance, λ the wave-length, both in kilometres, and a equals 0·0015. As it stands, the formula involves not only the law of propagation, but also the laws according to which radiation is detached from and absorbed by the antennae. The share of the sending antenna may be eliminated by considering the ratio of the currents received, according to the formula, by the same antenna when moved from the variable distance d

to a standard distance d_1; and then considerations of symmetry enables the share of the receiving antenna to be eliminated. In this way we arrive at the empirical result that the ratio of the electric fields at the places distant d and d_1 from the sender is inversely proportional to

$$d \exp \left\{ a(d-d_1)/\sqrt{\lambda} \right\} \div \lambda$$

This function diminishes steadily as λ is increased, which shows that waves of greater length always travel better than those of shorter length. But it ought to be remarked that this deduction must not be confused with those which are to be drawn directly from Austin's formula. That formula, taken as it stands, indicates that at any given distance the strength of signals received from a station working with constant antenna current, at first diminishes and afterwards increases as the wave-length is gradually increased. This is a different matter from the case of difficulty of propagation of waves over the surface of the globe between the antennæ.

Theory.—The large-scale experiments and facts outlined above caused great attention to be paid to the theory of the matter. Most of the mathematical physicists who have tried to find out why the waves bend round the earth have attacked the question from the point of view of diffraction theory. Diffraction, *i.e.*, the bending of waves of any kind round obstacles, has been deeply studied in optics and acoustics, and is a familiar enough phenomenon in the latter subject—everyone must have noticed that sound waves can turn, for example, the corner of a building, and that in doing so they lose intensity. The bulk of the energy in a sound wave travels in straight lines, and it may easily be imagined that only a small proportion would get round a quadrant of a sphere, from a source of sound on the surface of the sphere, if the sphere has a radius large compared with the wave-length of the sound. The problem of the exact amount of energy propagated round the sphere is a formidable one, but it has been tackled or discussed in the nearly analogous electrical case by a number of mathematicians. Among these are H. M. Macdonald, Lord Rayleigh, H. Poincaré, and J. W. Nicholson. All of them have taken the earth as a sphere of infinitely great conductivity surrounded by a homogeneous dielectric, and have thus probably put the diffraction case in the best light. The unanimous conclusion is that diffraction cannot account for the demonstrated facts of wireless telegraphy. Consider, for instance, the results deduced by Professor Nicholson. At 2,000 miles the energy

density in the medium is only 10^{-12} of that at the standard distance of 70 miles, the wave-length being about 400 metres; while at 6,000 miles the proportion is only 10^{-40}. In the *Marconigraph* of February, 1913, Professor Nicholson calculates that with long waves, such as those made by the Clifden Station, the energy ratio for 6,000 miles, as compared with 70 miles, is 3×10^{-17}. From these figures we may make the following deductions:—Assuming that a wireless telegraph station of power rating 300 watts can give readable signals at 70 miles at night, which is nearly enough the fact, then the power required to telegraph to Buenos Aires should be 9×10^{6} kilowatts. This must be held to dispose of the possibility of the signal waves bending round the earth by the mechanism of diffraction.

Before attention had been concentrated on the diffraction problem, Heaviside had made, in 1901, some interesting suggestions. He pointed out that the rarefied air at 50 or 60 miles above the earth's surface—which is, of course, in much the same state of attenuation as the gas in a Geissler tube—might assist wireless telegraphy by acting as a conducting shell enclosing the earth. Electric waves travelling to distances great compared with the height of the conductive layers might be conceived to travel with their vertical lines of force stretching from the conducting earth to the conducting sky; and these guides above and below would carry the waves round the globe just as electric waves in the laboratory can be carried along a pair of neighbouring wires. Further than this, Heaviside appears to be of opinion that even without a conducting sky the earth's surface should provide sufficient guidance to carry the lower portion of the wave-fronts round the globe almost as if the waves were expanding over a flat earth. Those who follow this suggestion will probably argue thus: Each travelling line of electric force in a wave-front ends at the earth's surface on a unit of electricity, and as the wave-front moves forward the foot of the Faraday line runs with its charge along the surface; and since, in the view of those who argue in this way, the Faraday line and its charge cannot be parted, and since the line cannot be broken, a wave disturbance emanating from a point on a perfectly conducting sphere must spread with its wave-front always normal to the sphere and with an electrical intensity as great near the sphere as anywhere. But this argument, if it is really as just stated, ignores the fact that as the wave-front bends over the sphere the parts nearest the sphere lose energy by radiation due to the central acceleration at every point of the

path; moreover, the surface charges appear to be moved at speeds greater than that of light; and thus it may be that if the tangential radiation is to be taken into account the matter reduces once again to the diffraction problem.

On the other hand, the hypothesis of the upper conductive layer is a very helpful and attractive one. The guidance it would offer to the waves if it were somewhat sharply defined is equivalent to a reflection, or series of reflections, round the globe, resembling the mode of operation of a whispering gallery. A difficulty inherent in it is to account for its conductivity under the feeble electric forces of attenuated signalling waves. In laboratory experiments with vacuum tubes, relatively enormous electric forces are applied to the rarefied gas and ionise it, till it is as conductive as an electrolyte; but under the unassisted electric forces in waves the conductivity would remain small. A suggestion that the upper layers may perhaps be maintained fully ionised by bombardment by dust caught up from outer space has been put forward by the present writer. If there is anything in it we should expect to find signals better in the dark hours before the dawn than in the hours following sunset, on the average. In any case, however, the hypothesis of the Heaviside reflecting layer, taken alone, leaves unexplained many of the facts of long-distance signalling.

Another hypothesis has been worked out by A. Sommerfeld and by H. W. March. Sommerfeld has shown that with a flat earth of finite conductivity Maxwell's equations indicate the possibility of dividing, for mathematical purposes, the wave-motion into three parts—namely, one propagated through the air, one through the earth, and one along the surface. The decrease of energy density in the two former follows the inverse square law if mere frictional absorption be neglected, and in the third follows the inverse first-power law. March's investigation extends to the case of a conducting sphere, and then the numerical results attained are of the same order as those of the diffraction theory. The hypothesis is of great interest and high theoretical importance, and may yet, in Sommerfeld's opinion, yield results in better accord with practical experience when more accurate numerical data are available. It is discussed by Sommerfeld himself in the *Marconigraph* of February, 1913. In the same issue Professor Nicholson advances good theoretical reasons for supposing that surface waves cannot account for propagation of signals round a quadrant of the globe, and

indicates that the method of discussion by surface waves is of the nature of a mathematical artifice rather than a physical fact. For a fairly detailed and eloquently favourable description of the surface-wave theory, the reader may consult a paper read by Professor Fleming at the Dundee British Association meeting.

But Sommerfeld's hypothesis is faced with several formidable difficulties. Lord Rayleigh has pointed out that it is hard to believe one paradoxical deduction from the hypothesis—namely, that signals would be propagated better over an earth possessing some small electrical resistivity than over one of perfect conductivity. Of course any considerable departure from perfect conductivity would, on the Sommerfeld hypothesis, hinder, and not help, wave propagation. The data available show that propagation should be much better over sea than over land. Now the most modern view of those who have practical experience is that, when long distances are in question, the difference between land and sea is negligible. The fact that there is a difference at all appears to be due solely to the portion of the earth passed over in the first 50 or 100 miles of the journey between the stations. Beyond that distance it is immaterial whether the track lies over land or sea, over steppes or mountain ranges—provided that the land is not so high and so near either station as to cast a shadow. Another difficulty in accepting the surface-wave explanation arises from the experience that at every distance up to 6,000 miles signals are enormously improved by increasing the height of the receiving antennæ, and so tapping higher strata—which would not be the case if the bulk of the energy were conveyed by surface waves. Still another difficulty arises when the great and rapid changes of signal strength that occur at distances of 300 miles and over are considered.

Starting from the fact that the resistivity of the lower air is insufficient to account for the weakening of long-distance signals by sunlight, Professor Kennelly has suggested that the Marconi phenomenon may be due to an outward bending of the waves in those layers of the atmosphere ionised by sunlight; such an outward bending would undoubtedly be produced if the waves travelled more slowly through ionised air than through unionised air. Later, Professor Fleming suggested that the ions responsible for the slowing of the waves were the small, uncharged globules of water known to exist in the atmosphere. Any outward bending would, of course, have the same ultimate effect on signals as frictional absorption. However, it seems very plain

that if we are to add to the conclusions of the diffraction theorists a hypothesis that the waves are deflected outwards by heavy ions in the air, we are only aggravating the difficulty of understanding why signals do, in fact, creep round the globe at all, especially in the daytime.

We come now to a hypothesis proposed and partially worked out by the present writer in Vol. 87 of *The Proceedings of the Royal Society* (1912). The hypothesis is applied to the explanation of many of the great and small phenomena of long-distance wireless telegraphy in a British Association paper, reprinted in part in the *Marconigraph* of November, 1912. The hypothesis attempts especially to explain the phenomena produced by sunlight, and is grafted on to Heaviside's upper-layer hypothesis in order to explain other phenomena.

In the Royal Society paper evidence is quoted to show that sunlight causes electrons to split off from some proportion of the molecules of the air, and so creates electrically charged molecules or groups of molecules, the so-called ions. Ions of molecular size will be formed best in the higher regions of the atmosphere where there is little water vapour, and where the solar radiation still possesses great ionising powers. It is reasonable to suppose that the number of ions per cubic cm. must increase as distance from the earth increases, up to, possibly, some limiting height of the order of 100 miles. Now, in the paper cited, it was shown mathematically that the velocity of Hertzian waves in air containing small ions is greater than that in unionised air. It was shown also that the percentage increase of velocity is proportional directly to the concentration of the ions and to the square of the length of the waves; and that in air containing heavy charged ions—such ions as are formed in the lower levels where water vapour exists—the increase of velocity is small and almost independent of the wave-length. It may be mentioned in passing that water globules not carrying an electric charge will probably cause a minute diminution of the velocity of electric waves. It is convenient to call the part of the atmosphere where the ions are mostly uncharged and heavy, the lower atmosphere; the part where they are heavy but charged, the middle atmosphere; the part where they are of molecular size, charged, and with long free paths, the upper atmosphere. It seems reasonable to take the middle atmosphere as included between the levels 10 and 20 miles above the earth's surface.

In a medium in which the speed of waves is greater at higher

levels than at lower, waves travelling horizontally (and therefore having vertical wave-fronts) have their wave-fronts tilted forward as they travel; in other words, the " rays " of such radiation are not straight lines, but are curves with their concavity downwards, like the trajectory of a rifle bullet. Taking this fact with the other statements made above concerning the state of our atmosphere in daylight, we arrive at the following conclusions: A Hertzian ray started horizontally from a point on the earth's surface will travel in a straight line through the lower atmosphere, and will enter the middle atmosphere after travelling about 280 miles; if it continued to move in a straight line it would reach the level of the upper atmosphere at about 400 miles from the starting-point. But under the hypothesis it would be refracted downwards to an extent depending on the degree of ionisation, and might at some level actually become more curved than the earth is, and thus be turned down into the lower atmosphere, and, after traversing this in a straight line, again reach the earth's surface. On the other hand, a ray starting with some angular elevation would traverse a straight path in the lower atmosphere, a somewhat bent path in the middle atmosphere, and a more sharply bent path in the upper atmosphere, and may, if not started too vertically, again reach the earth. The ray will reach the upper atmosphere the sooner the greater its starting elevation, of course; and the only thing that helps us to judge whether telegraphy is accomplished, in any particular case, by rays bent in the middle atmosphere or mostly by rays bent in the upper atmosphere, is the theoretical consideration that the bending of the rays in the upper atmosphere is much greater for long waves than for short. Now in telegraphy over distances of the order of 2,000 miles, long waves have been found much better than short, and we may conclude that the upper atmosphere, and not merely the middle, is utilised.

An interesting fact has recently been noticed about the transmission from Manaos to Porto Velho, a distance of about 450 miles, over Brazilian forest. The stations are situated in clearings, and the trees standing round the clearings are of much the same height as the antennæ. The rays that escape over the tops of the trees must be directed upward, and by those rays the transmission is effected. It was found that in the day time great advantage accrued from lengthening greatly the wave originally used. From this we conclude that these upwardly directed rays are deflected downwards in the upper atmosphere—

in other words, the *upper* atmosphere is utilised, in this case, on a relatively short range. We may conclude that it assists in every similar range, whether the antennæ are or are not screened by trees.

At nightfall the ions in the atmosphere for the most part recombine. Transmission round the bend of the earth is then carried on, we must suppose, by the Heaviside reflecting layer; and universal experience shows that this is better, in electrically quiet conditions of the upper atmosphere, than the ionic refraction of the day. Moreover, short waves are as easily reflected as long, while, on the contrary, long waves are more refracted by ionised air than short waves. There are, therefore, astounding differences between day and night long-distance transmission when short waves are used. But the conductivity, and consequently the reflecting power, of the Heaviside layer depends greatly on the presence of local electromotive forces—the erratic nature of which is known from the phenomena of auroral and magnetic storms. On the contrary, the ionisation produced by the sun in the day, especially in the layers below the Heaviside layer, is practically uninfluenced by local electromotive forces, and therefore gives steadier conditions for long-distance signalling—especially if long waves and, by hypothesis, somewhat low trajectories are used. Hence we should expect great freakishness in night transmissions, as compared with day—which agrees very well with the experience of telegraphists, and is especially in accord with the Transatlantic experience described by Mr. Marconi in his Royal Institution discourse of June, 1911.

It may be asked: Why, over long distances, are the best night signals better than the best day signals? This question might be answered by alleging that there is considerable absorption, of frictional type, in the ionised atmosphere of the day time. But even without absorption there is a good reason for the difference. There must exist in the day conditions what may be called, in optical language, geometrical aberration; that is to say, only a few selected rays can have trajectories passing directly from sender to receiver.

In concluding this account of the facts and theories of the transmission of signals over the convex surface of the globe, the opportunity may fitly be taken of urging all those who work with long-distance signals to place on record from time to time the fruits of their experience, and thus assist towards the fuller understanding of the whole remarkable phenomenon.

METHODS OF PRODUCING CONTINUOUS WAVES

By C. E. Prince.

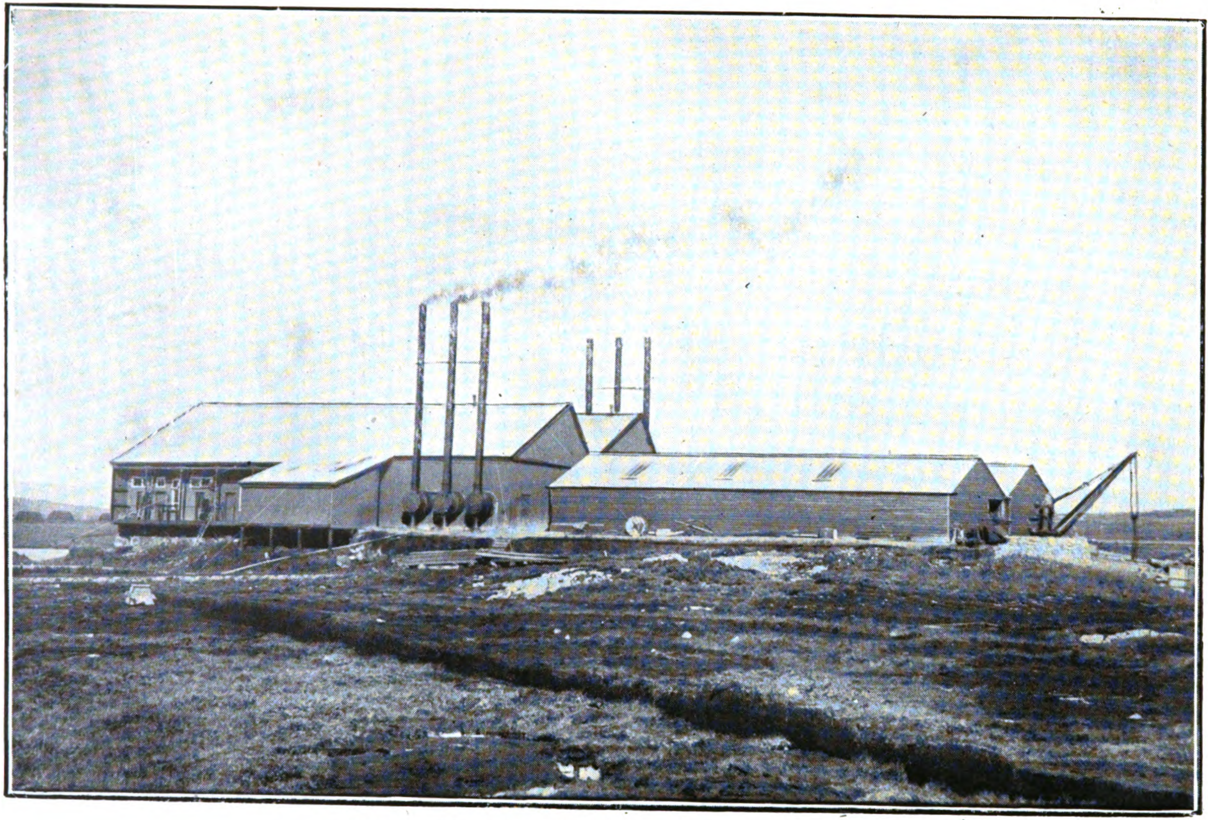
FROM a very early stage in the history of the subject the use of continuous waves in wireless telegraphy, instead of the intermittent trains of oscillations given by any form of spark, has always proved an attractive goal for inventors, on account of the advantages which would apparently attend it; and it is exceedingly interesting to review the progress that has been made up to the present, and to consider how far these advantages are real or illusory.

When a violin string is sounded by a bow the sound continues with undiminished intensity as long as the bow continues to be drawn across it; but if the same string be plucked the sound rapidly dies away. The sounding string is all the time giving up its energy to set the air in motion, but in the first case this energy continues to be supplied by the bow as fast as it is given up, while the plucked string can only draw upon the supply of energy stored up in itself by virtue of its mass, and each excursion of the string becomes smaller, till soon the sound dies away.

The bowed string is an example of continuous oscillation, the plucked string of a damped oscillation, and the ether waves used for wireless telegraphy can exhibit similar characteristics.

In spark-telegraphy the energy stored in a condenser connected in series with an inductance is suddenly released in a spark, and by virtue of the inertia of the magnetic field formed by the coils of the inductance, the current surges to and fro till it is brought to rest by the loss of energy. This may be lost either in the resistance of the circuit, as heat, or in radiation; that is, in setting the neighbouring ether in motion, just as the string set the air in motion. In the latter case this caused sound waves to travel out, and in the electrical case ether waves, and the whole number of oscillations, from the beginning till they die away, is called a " wave-train "!

The ratio of one maximum to the one preceding it in the opposite direction is called the *damping* of the oscillations, and the



Marconi Transatlantic Station at Clifden (Ireland).

[To face page 396

logarithmic decrement δ is the Napierian logarithm of this ratio; and, this being known, the number of oscillations in the train can be easily found by applying the simple formula $\frac{n=4{\cdot}605+\delta}{\delta}$, where n will be the number of semi-oscillations which take place before the amplitude is reduced to one-hundredth of its initial value—that is, practically to zero.

Now since most receivers depend for their effect upon the total amount of wave energy they pick up, and not upon the maximum amplitude attained by the wave train, it is usually more efficient to send out a long wave train, having a great number of oscillations before it dies away, rather than a train beginning with one or two oscillations of greater intensity which immediately falls off.

Here we are in a slight dilemma, for our object is to radiate energy, and yet if we radiate it too fast we introduce a heavy damping, which of itself prevents the attainment of a long wave-train. This, in fact, was the behaviour of the "Plain Aerial," which was a so much better radiator than storer of energy that it could only emit short and highly damped wave-trains.

The invention of the coupled circuit by Mr. Marconi—the great 7777 patent of 1900—showed how it was possible to draw upon a larger supply of energy than could be stored up by charging the aerial alone, and hence, for the same rate of radiation, to produce much more persistent wave-trains. Moreover, by altering the proportions of the circuits, and the coupling between them, the various factors were to a large degree controllable.

But why is it not possible to supply energy as fast as it is radiated away, as in the case of the bowed violin string?

The answer lies in a matter of degree. We must remember that in treating of oscillations we are dealing with frequencies of a high order, and that the frequency of the sparks, or wave-trains, belongs to quite another. The oscillation frequency will be of the order of about a million a second; that of the sparks, or trains, of the order of one or two hundred a second. It is very instructive to take a sheet of paper, and, after drawing to any pre-arranged time-scale a train of, say, 30 oscillations of this frequency, draw another separated from it by the proper interval of the spark frequency. The wave-train will be seen as a tiny duration, separated by a great distance of time from its fellow; and in all this blank time space no energy is being transferred from sender to receiver. This useless blank can be diminished

either by increasing the train-frequency, or increasing the persistence of the wave-train, or decreasing the oscillation frequency of the wave. The first is limited by the highest note which will be acceptable to the ear—and it is worthy of notice that a high note is found to be very tiring to the ear, and hence physiologically inefficient—the second tends to encroach upon the radiation dilemma, and the last has various obvious limits. Nevertheless, by properly proportioning these factors, a great station like that of the Marconi Transatlantic service does approach very nearly to optimum conditions of efficiency; for though the receiver (using the word in its most comprehensive sense to include both the instrument and the human ear) is to some extent integrative, it has been found experimentally that it can only integrate the effect over a certain small period, and that then it reaches a maximum useful effect in the telephone; and this period does not exceed the duration of a good spark-produced wave-train; so that for a given quantity of energy there is nothing gained in this respect by spreading its emission over a longer period.

Moreover, the plain spark-gap of the early days, though still retained in small work and emergency sets, has given way to improved methods of producing the spark. One of these, the "quenched spark" of the German Telefunken Company, was originally suggested by Professor Wein. In this system the gap is a very small interval between two flat metal discs, many such gaps being used in series for the larger powers. The secondary or aerial circuit is tightly coupled to the primary, and the current in the latter, after having given up its energy to the aerial and set it in oscillation, ceases, and the circuit remains open. The aerial is thus left to radiate away, at its natural frequency, the energy it has received, without any reaction on the primary to produce a double wave or involve loss in the primary circuit. This is very like giving to the violin string of our first illustration a very short stroke of the bow and then leaving it free—a "spiccato" note, as against the "pizzicato" of the plain aerial or highly damped wave. This system has proved very successful and is largely in use. In spite, however, of the claims made for it, it is perhaps open to doubt whether in the short space of time during which the primary is acting on the secondary, the latter (other things being equal) attains to an amplitude as great as it would have in a non-quenched spark system.

Perhaps the greatest advantages attainable are offered by the Marconi revolving disc. In this the spark occurs between

rapidly rotating and fixed studs, upon which plays a blast of air to blow out any arc that may form and to assist the cooling. The spark begins on the approach of the studs, and as the charge of the condenser becomes less the spark length and spark-resistance is also being reduced, till, when the condenser is fully discharged, the studs separate again. The wave-train produced by the disc discharger is a very persistent one and the efficiency is high, while it stands alone in the highly important respect of being able to deal, without loss of efficiency, with the very largest powers. It also gives a musical note which is very clear and grateful to the ear.

If the aerial circuit be appropriately coupled to the primary the effect produced is similar to that of the quenched spark, and only a single wave is radiated from the aerial. In order to utilise and increase this effect several discs in series have been used.

Having thus reviewed shortly the position with regard to telegraphy with damped oscillations, let us now consider undamped or continuous oscillations, which are simply alternating currents of high frequency. Several methods of producing them have been developed and published; these are respectively the arc and alternator systems, and a highly ingenious method that has been developed by Mr. Marconi and which involves the use of neither the arc nor the alternator, but is a new mechanical method of great simplicity, and with which communication has already been established by day and night across the Atlantic. Other methods have been developed but not yet made public. The first-named owes its origin to Duddell's discovery of the singing arc in 1900, when he found that a direct-current arc, shunted by a capacity and inductance of proper value, gave out a musical note; that is, it produced a continuously pulsating or oscillating current.

Since the theory of this phenomena is a commonplace of text-books, no space need be wasted in discussing it, but we may turn to the development of it by Valdemar Poulsen, whose system is at present the only one using the Duddell arc as a generator of an oscillating current.

Poulsen's important improvements consisted in placing the arc in an atmosphere of coal gas or hydrogen, and employing poles of carbon (−) and copper (+), the latter being kept water-cooled. To enhance the strength and frequency of the oscillations the poles of a powerful electro-magnet are placed so that their field is transverse to the arc. The carbon pole is also continuously rotated, to expose a fresh surface and prevent the formation of irregulari-

ties. The arc being shunted by a condenser and inductance of a frequency corresponding to the usual "wireless" wave, this circuit is set in oscillation, and the oscillation continues unabated as long as the apparatus is worked. These waves are undamped in the sense that their decrement is zero and all their amplitudes equal, but the current is not strictly sinusoidal in form, though it is nearly so under favourable conditions.

It is plain that these waves will not be able to affect a telephone receiver, because their frequency is far beyond the audible limit, and also the mechanical limit of the telephone, and when rectified by a detector they would appear as a continuous current in one direction; so that to become audible they must be interrupted or broken up into groups, separated by null periods. At the sending station this breaking up need not be done by actually interrupting the circuit, but can be achieved by throwing one of the circuits in and out of resonance by shunting an inductance, which causes a corresponding strengthening and weakening of the effect to which the telephone responds. The energy is then transmitted in groups of waves similar to the groups sent out by the spark, except that each group or train shows no damping, but the last wave of each group is of the same amplitude as the first, and it is possible to make the null period no more than equal to, or even shorter than, the duration of the group. On the other hand, it must be remembered that the maximum intensity of the train, though persistent, is very much less than that of the spark-train.

Instead of so breaking up the oscillation at the transmitting end, Poulsen devised a highly ingenious method of doing so at the receiving station by means of an interrupter he called the "tikker." This is a vibrating contact, of musical frequency, which alternately connects and disconnects a condenser placed in parallel with another in the receiving circuit, and causes the musical note of the vibrating interrupter to be heard in the telephone connected to the detector as long as the receiving aerial is picking up the energy of the continuous wave reaching it. It is claimed that by the use of the tikker the energy of the null periods is received and stored up in the condenser, to be given out when contact is made again, so that the period is not wasted; but Professor G. W. Pierce explains it as merely the action of putting the circuit in and out of resonance, which would make it equivalent to interruption at the sending station, and the null periods a dead loss. However, admitting the inventor's explanation of its action, the use of the tikker has one drawback, which for long distance and big work

generally is very serious indeed. That is, that when atmospherics are weak and continuous, as they are on large aerials at many times—a condition under which musical-spark telegraphy can work perfectly—the tikker makes no distinction between the charge given to the aerial by the friendly wave or the hostile "X," but both are reproduced in musical sound, and telegraphy becomes temporarily impossible.

This defect would be fatal for high-speed recording, and it is probable, therefore, that the advantage claimed for the use of the tikker will not be available in practice, but the wave will have to be broken up at the sending station. In this case, also, the advantage that the continuous wave station is inaudible on an ordinary receiver would be lost, which is regrettable, for although this can hardly be said to amount to secrecy (as is often loosely thought) it would certainly be a good thing, in a world already too crowded with ether-waves, to be able to relieve the pressure by a mixture of both kinds of station. It does not follow, however, that this immunity is reversible and that a continuous-wave station is immune from interference by a spark station.

It is worthy of note here, in speaking of high-speed recording, that this is easy with any system using small powers and small aerials, and in the absence of atmospherics. The only test worth mentioning is its practicability for large powers under any conditions. The continuous wave can, of course, without any interruption or breaking-up, affect such an instrument as the Einthoven galvanometer, and at first the combination of the two appears most attractive; but the Einthoven cannot be used at all times, and for commercial day and night working the most practicable system remains the one which leaves intact the blessed power of the human ear to distinguish signals from the crackle of atmospherics.

Perhaps the most interesting feature of the arc, and continuous wave system generally, is its application to wireless telephony. The inaudibility of its unvaried wave is exactly the condition necessary for this, since its intensity only needs to be modified by a microphone in accordance with the voice, and the speech is reproduced by any receiver. It should be noted that it is not because the wave has no damping, but because there is no group or other frequency to come within audible limits, that this obtains, and if it were possible to produce damped wave-trains following one another with ultra-audible speed they would serve for telephony. Little progress, however, seems to have been made in this direction, though the writer has recently made some

encouraging experiments on a small scale. It is not easy to construct a microphone to deal with the large currents necessary to work with any power, the most successful being the water-jet microphone of Professor Majorana; but at various times considerable distances have been attained by telephony, and, to be frank, it is only the somewhat intricate nature of the arc, the generator of the oscillations, which renders it at present rather unpractical.

In short, the arc system of producing continuous waves, though much improved in the latest types, and always very interesting, is open to many objections, and it seems unlikely that the future belongs to it. It involves many factors, such as water cooling, gas circulation, and more or less constant attention to the electrodes, which need to be renewed as they burn away; which renewal is an interruption to the adjustments. The arc is liable to slight fluctuations of frequency, which, though not large, may prevent advantage being taken of the otherwise sharp tuning which belongs to continuous waves.

Besides the Poulsen arc there are other representatives of this group, such as the multiple air-arcs in series, the mercury-vapour arc, and the arc in steam. These can hardly be regarded, however, as more than experimental devices; though with an ingenious modification of the last-named Prof. Vanni claims to have attained to a great distance in telephony.

In turning to regard the high-frequency alternator we seem to look more in the direction from which will come future developments. It is unnecessary to go into all the attempts which have been made by Duddell, Fessenden, and others to produce such a machine, in designing which the chief difficulty was to attain to anything more than very small powers; but it suffices to say that at the present time a practical alternator for small powers can be, and is, made for a frequency of 100,000 per sec., having an output of two or three kilowatts; while the Goldschmidt machine seems to offer possibilities in a slightly different direction.

The greatest obstacle to the use of the alternator for wireless is the matter of speed regulation. Since, of course, the "tune" or wave-length depends directly upon the speed of the machine, it needs extremely fine regulation to keep this constant enough for good tuning at the receiving station; and more especially if it is desired to use to the full the sharp tuning of the continuous wave. For telephony the alternator is very satisfactory: the slight hissing sound due to the irregularities of the machine seems to be

easily swamped by the voice, and on the whole it is more silent than the arc.

In the foregoing few pages it has not been possible to make more than a hasty survey of the vast field covered by the subject under discussion. But it has sufficed to show us how intimately the practicability of using continuous waves is bound up with their possible means of production.

As regards the waves themselves, nearly every advantage they offer is run very close by spark telegraphy. They admit of very sharp tuning, but it is difficult to take advantage of it. Dr. Eccles has recently shown that the efficiency of resonance of spark-trains can be as high as 90 per cent., leaving not much improvement to be effected by continuous waves, even perfectly syntonised. Their inaudibility is equally attainable by damped trains of ultra-audible frequency; and over long distances they are not less liable to absorption or loss in traversing ionised regions. On the other hand, they are, from a scientific point of view, very attractive, and it will be interesting to observe coming developments.

USEFUL FORMULAE AND EQUATIONS

We present here for the convenience of our readers a number of formulae and equations useful in radiotelegraphy, collected from various places. Those marked with an asterisk (*) have been taken by special permission of the Author and Publisher from Dr. J. A. Fleming's well known treatise on "The Principles of Electric Wave Telegraphy and Telephony," published by Longmans, Green & Co., of 39 Paternoster Row, London, E.C.

HEADING	FORMULA	REMARKS
1. Sine wave . . . . (Alternating current or undamped oscillation).	$i = I \text{ Sin } 2\pi n t$	Gives instantaneous value i of current at time t secs in terms of max. value of current I, t, and the frequency n (number of complete cycles per second).
	$\text{Frequency} = n = \dfrac{\text{Revs. per min.} \times \text{number of poles}}{120}$	
2. Impedance . . . . In circuit having Inductance and Resistance only.	$\text{Impedance} = \dfrac{\text{Volts}}{\text{Amperes}}$	
	$\text{Impedance} = \sqrt{4\pi^2 n^2 L^2 + R^2}$	Where L is Inductance in henrys and R is Resistance in ohms.
	$= \sqrt{L^2 p^2 + R^2}$	Where $p = 2\pi n$.
	$= \sqrt{\text{Reactance}^2 + \text{Resistance}^2}$	
	$\text{Impedance} = Lp$	If Resistance is negligible.
3. Impedance . . . . In circuit having Capacity and Resistance only.	$\text{Impedance} = \sqrt{R^2 + \left(\dfrac{1}{Cp}\right)^2}$	Where $p = 2\pi n$ as before and C is Capacity in farads.
4. Impedance . . . . In circuit having Capacity only.	$\text{Impedance} = \dfrac{1}{Cp}$	If Resistance R is negligible.
	$\text{so } I = \dfrac{E}{\frac{1}{Cp}} = ECp$	Where I is max. value of current, and E the applied P.D. in volts.
	$= 6{\cdot}28nEC$	For $p = 2$ $n = 6{\cdot}28n$.
	Therefore Root-mean-square current $= 4{\cdot}4nEC$	Because for sinusoidal currents R.M.S. current / max. current $= 1/\sqrt{2} = {\cdot}707$.

5. Impedance . . . . In circuit having Inductance, Capacity & Resistance.	$\text{Impedance}=\sqrt{\left(Lp-\frac{1}{Cp}\right)^2+R^2}$ $=\sqrt{(\text{Reactance}-\text{Captance})^2+\text{Resistance}^2}$	
6. Angle of Lag and Power Factor.	$\tan\theta=\frac{\text{Reactance}}{\text{Resistance}}$ $\text{Cos}\theta=\frac{\text{Resistance}}{\text{Impedance}}$ $=\text{Power Factor}$	Where θ is angle of lag of current behind applied P.D.
7. Resonance	Condition for Resonance $Lp=1/Cp$ whence $n=1/2\pi\sqrt{CL}$ and $T=2\pi\sqrt{CL}$	Then Impedance reduces to Resistance only. Where T is time in secs. of a complete oscillation.
	$T=2\pi\sqrt{I/K}$	Compare the general formula for Simple Harmonic Motion, namely Where I is moment of inertia and K is the ratio of the torque to produce displacement θ to θ.
8. Oscillatory Discharge .	Condition for Oscillatory discharge R must not be greater than $\sqrt{4L/C}$	If R is nearly as great as $\sqrt{4L/C}$, n becomes smaller than the value given by formula 7.
9. Velocity of Propagation and Wave Length . . .	Velocity of electro-magnetic waves $V=185{,}000$ miles per sec. $=300{,}000{,}000$ metres per sec. $=3\times10^{10}$ cms. per sec. $V=n\lambda$	General formula connecting frequency, wave length and velocity.

HEADING	FORMULA	REMARKS
Velocity of Propagation and Wave Length—*cont.*	From (7) which is Lord Kelvin's formula we see that $n = 1/2\pi\sqrt{CL}$	Where n is the number of complete oscillations per sec.
	and therefore from (9) $\lambda = \text{Vel. of Light}/n$ $= 3 \times 10^{8} \times 2\pi\sqrt{CL}$ metres.	Where C and L are in absolute units. But the absolute elec. mag. unit of capacity $= 10^{9}$ farads. or 10^{15} mfds. And the absolute unit of Inductance $= 10^{-9}$ henrys, or 10^{-3} mhys.
	Hence $\lambda = 3 \times 10^{8} \times 2\pi\sqrt{CL/10^{12}}$ $= 1885\sqrt{CL}$ metres, approx. $= 6182\sqrt{CL}$ feet.	Where C and L are mfds. and mhys. respectively.
	and also, using the same units.	
10. Frequency	$n = 160{,}000/\sqrt{CL}$ approx.	Complete oscillations per sec.
11. Electro-static and Electro-magnetic Units . .	Ratio of $\frac{\text{electromagnetic unit}}{\text{electrostatic unit}}$ of Quantity is equal to v of Current " " v of Resistance " " $1/v$ of Potential " " $1/v$ of Capacity " " v^2 of Inductance " " $1/v^2$	Where v is the velocity of light and equals 3×10^{10} (cms. per sec.)

12. Practical Units . .

Symbol	Quantity	Practical Unit.	Equivalent in electromagnetic absolute units.	Remarks
I, i	Current	Ampère	10^{-1}	
E, V	Electromotive Force	Volt	10^{8}	
L	Inductance	Henry	10^{9}	1 cm. of Inductance is the electromagnetic unit and 1 microhenry =1,000 cms.
C	Capacity	Farad	10^{-9}	1 cm. of Capacity is the electrostatic unit, and its connection to the farad and microfarad is given by tables (11) and (12).
R, r	Resistance	Ohm	10^{9}	
P	Power	Watt	10^{7}	
W, J	Work or Energy	Joule	10^{7}	
Q	Quantity	Coulomb	10^{-1}	

13. Damped Oscillations.

* $L = I\epsilon^{-\alpha t}\operatorname{Sin} 2\pi n' t$

General equation (compare with 1) ϵ is base of Napierian logs α is a constant and is called the "damping factor."

14. Damping of non-radiative non-coupled circuit

* $I_1/I_2 = I_2/I_3 = \ldots = \epsilon^{\frac{\alpha T}{2}}$

* and $\alpha T/2 = \alpha/2n = R^1/4nL$

$= \delta \ldots.$

Where R^1 is the high-frequency resistance.

The logarithmic decrement per half-period. R^1 in ohms, L in henrys or both in absolute.

* so $\epsilon^{\delta} = I_1/I_2 = I_2/I_3 \ldots.$

* and $\delta = \log_{\epsilon} I_1/I_2 = \log_{\epsilon} I_2/I_3 \ldots.$

* $I_1/I_m = \epsilon^{(m-1)\delta}$

Where I_1 is the first max. of current, I_m is the m^{th} max.

HEADING	FORMULA	REMARKS.
14 Damping of non-radiative non-coupled circuit—*cont.*	If we suppose the oscillations to be extinguished when $I_1/I_m=100$, i.e., when the last is only 1% of the first,	
Number of Oscillations in Train.	* $m=\frac{4{\cdot}605+\delta}{\delta}$	Giving the number of half-oscillations before max. value is reduced to 1% of its initial value. So the number of complete oscillations constituting the wave-train for practical purposes $=m/2$.
Two coupled circuits, each with damping.	* $\delta_1+\delta_2=\pi\left(1-\frac{n_2}{n_1}\right)\frac{J}{\sqrt{J_r^2-J^2}}$	Where the frequencies of the two circuits are n_1 and n_2 (nearly the same) gradually brought nearer so that finally $n_1=n_2$ giving resonance; and J is the R.M.S. value of secondary current, increasing to J_r with resonance.
Determination of decrements.	* If a resonance curve be plotted, with a hot-wire ammeter in the secondary circuit, in which the ordinates represent the values of J^2/J_r^2 and the abscissae the fraction n_2/n_1 this gives us a curve with a max. ordinate equal to unity and a corresponding abscissa also equal to unity. Then if y is an ordinate very near to the maximum, and if $x=1-n_2/n_1$ $\delta_1+\delta_2=\pi x\sqrt{\frac{y}{1-y}}$	
15. High frequency Resistance	* $\frac{R^1}{R}=1+\frac{k^2}{48}-\frac{k^4}{2880}+\ldots$ (*Lord Rayleigh's formula*)	Where R is resistance of the wire (straight cylindrical) for constant currents, and R^1 is res. of same for h.f. currents.

	* if $k=\pi^2 d^2 n\mu/\rho$ But if k is greater than 5 or 6, then $\frac{R^1}{R}=\frac{1}{2}\sqrt{k}$ If the wire is non-magnetic $\mu=1$ * If the wire is of copper, at ordinary temperatures, $\rho=1640$	d is diam. of wire in cms. ρ is spec. res. in cgs. electromagnetic units. n is frequency. μ is magnetic permeability of material.
16. Mean Square Value .	Mean-square value (integral value) of oscillations having N trains or groups of oscillations per second is * $J^2=\frac{NI^2\epsilon\delta}{8n}$ *	Provided δ (the decrement) is not greater than say $\pi/10$.
17. Coupling	* $k^2=\frac{M^2}{L_1L_2}$	Where k is the coefficient of coupling, M is the mutual inductance of primary and secondary, L_1 and L_2 are the self-inductances of primary and secondary.
	* $T_1=T\sqrt{1+k}$ $T_2=T\sqrt{1-k}$ * $n_1=\frac{n}{\sqrt{1+k}}$ * $n_2=\frac{n}{\sqrt{1-k}}$ * $\lambda_1=\lambda\sqrt{1+k}$ $\lambda_2=\lambda\sqrt{1-k}$ * and $k=\frac{\lambda_1^2-\lambda_2^2}{\lambda_1^2+\lambda_2^2}$	Where T, n, λ are the time-period, frequency and wave-length of each circuit separately, and T_1, T_2, n_1, n_2, and λ_1, λ_2 are the corresponding values of the two resultant waves produced by coupling.

HEADING	FORMULA	REMARKS
18. Capacity . . . . . Sphere in space, radius r cms.	$C = r$ cms. $= \frac{r}{9 \times 10^5}$ from (11 and (12)	Electrostatic units. Microfarads.
Cylindrical condenser. (air dielectric)	C per unit length $\frac{1}{2 \log_\epsilon b/a}$	Where a and b are outer and inner radii. Applies approximately to jars.
Parallel plates. (air dielectric)	$C \;\; \frac{A}{4\pi d}$	Electrostatic units, d being distance apart in cms., small in comparison with length and breadth of plates, and A = surface in sq. cms.
	Parallel plate air condenser, 1 cm. spacing, C per sq. metre . . about ·00088 mfd.	
Long Wire.	$C = \frac{l}{2 \log_\epsilon 2l/d}$	In space; l is length in cms. d is diam. in cms. Add about 10% for nearness to earth.
Banks of Condensers.	$R = \sqrt{MC / j}$ and $M = Rr$	Where R is rows of jars in parallel. r is " " series. M is total number of jars. C is Capacity required. j is Capacity of each jar.
19. Energy in Condensers	$J = \frac{1}{2} QV$ But $Q = CV$ So $J = \frac{1}{2} CV^2$	Where Q is number of coulombs. C is capacity in farads. V is voltage to which it is charged. J is number of Joules stored.

20. Inductance . . . . Cylindrical-sectioned wire, one turn, in form of square.	*	$L=2l\,(2{\cdot}303\log_{10}4l/d-2{\cdot}853)$	Where l is length in cms. d is diam. in cms. Absolute units.
In form of circle.	*	$L=2l\,(2{\cdot}303\log_{10}4l/d-2{\cdot}45)$	Strictly, this is for infinite frequencies, but it is sufficiently accurate for ordinary wireless frequencies.
Solenoid, single layer.		$L=4\pi^2n^2\left(\frac{2a^4+a^2l^2}{\sqrt{4a^2-l^2}}-\frac{8a^3}{3\pi}\right)$ (*Cohen*)	Absolute units, where r is mean radius, n is number of turns per cm. length, l is length in cms.
Single wire, straight.	*	$L=2l\left(2{\cdot}303\log_{10}\frac{4l}{d}-1\right)$	Absolute, l is length in cms. d is diam. in cms.
21. Energy stored in Inductance		$J=\frac{1}{2}LI^2$	L is Inductance in henrys. I is amperes flowing. J is number of Joules stored.
22. Horse-Power . . .		Indicated Horse-power $=\frac{plan}{33{,}000}$ or for double-acting engine = twice this. 1 H.P. = 33,000 ft. lbs. per min. = 550 ,, per sec. 1 H.P. = 746 watts. 1 Kilowatt = 1000 Watts = 10^{10} ergs per sec. = 737·3 ft. lbs. per sec. = 1·32 H.P.	Where p is mean effective pressure per sq. inch (from indicator diagram). a is area of piston in sq. ins. l is length of stroke in feet. n is number of working strokes per minute.

HEADING	FORMULA	REMARKS
22. Horse Power—*cont.*	A good horse walking $2\frac{1}{2}$ miles per hour exerts for 10 hours a tractive force of 100 lbs., equivalent to 22,000 ft. lbs. per minute. For 5 hours a tractive force of 200 lbs., equivalent to 44,000 ft. lbs. per minute. A man hauling along a level road at $1\frac{1}{2}$ to 3 miles per hour is reckoned at $\frac{1}{8}$ of a H.P. for a 10-hour day; i.e., he does 3,670 ft. lbs. per minute for a 10-hour day. Turning a handle, he does 2,600 ft. lbs. per minute for a 10-hour day.	Thus a H.P. is more than he can do for 10 hours.
Safe H.P. for Shafting.	$\text{Diam. of Shaft in inches} = 3{\cdot}69\sqrt[3]{\dfrac{\text{H.P. transmitted}}{\text{Revs. of shaft per min.}}}$	
23. Magnets	Magneto-motive force $=4\pi nC$ $=4\pi nC/10$	in cgs. units, C being the current. If current is in amps.
	$\dfrac{\text{Magneto-motive force}}{\text{flux}} = \text{Reluctance}$ $= \dfrac{\text{length}}{\text{area} \times \text{permeability}}$	
Tractive force of Permanent magnet.	$p = a\sqrt[3]{w}$	p is weight in kilograms which magnet will carry, w is weight of magnet in kilograms, a varies (for steel of good quality) from 18 to 23.
Length of Wire on Bobbin.	$L = 21820\dfrac{l}{\delta^2}(D^2 - d^2)$ yards	Where D is diam. of bobbin in inches l is length ,, ,, ,, (inside) d is diam. of core in inches δ is diam. of wire in mils (1 mil $= \frac{1}{1000}$ inch).

	If d = diam. of wire of a magnet whose resistance is r ohms, to fill the bobbin so as to give a resistance r^1 we must use a wire of diameter d^1 where $$d^1 = d\sqrt[4]{r/r^1}$$	If d^1 is less than d, the actual gauge used should be rather smaller than that given by formula, and vice-versa.
24. Rope, Strength of—	Hemp. $\frac{\text{Circumference in inches}}{3}$ = breaking load in tons. Wire Rope. (Circumference in inches)$^2 \times \cdot 3$ (iron) or (Circumference in inches)$^2 \times \cdot 8$ (steel) gives safe load in tons for BEST ropes. In all cases, Breaking load = about 3 times Safe Load.	
Elongation of Stays.		
All-wire rope	Elongation $0{\cdot}25 \times S/c$ %	Where S = load in tons. c = circumference in inches.
Wire rope with one main hemp core.	" $0{\cdot}3 \times S/c$ %	
Wire rope with main hemp core, and hemp core in each strand.	" $0{\cdot}5 \times S/c$ %	Thus, if the value comes out to 0·05 %, this means that 100 feet will stretch 1/20 of a foot, owing to the tightening-up of the wires composing the rope.
Weight.	Weight in lbs. per fathom = square of circumference in inches.	Thus 4″ wire rope would weigh about 16 lbs. per fathom.
Miscellaneous	1 Inch = 2·54 cms. 1 cm. = ·3937 inch. 1 Foot = ·3048 metre 1 metre = 3·28 feet. 1 Mile = 1·61 kilometre 1 kilometre = ·62 mile. 1 Mile per hour = 1·466 feet per sec.	

HEADING	FORMULA	REMARKS
Miscellaneous—*contd.*	1 Grain = ·065 gram. 1 Ounce = 28·35 gram. 1 Kilogm. = 2·204 lbs. ($2\frac{1}{5}$ lbs.) 1 Litre = 1·76 pints = 61 cubic inches. 1 Lb. per sq. inch = 2·31 feet water = 2·04 ins. Mercur. 1 Atmosphere = 14·7 lbs. per sq. inch. 1 Cubic foot water weighs 62·35 lbs. (1,000 oz.) 1 Gallon (Imperial) weighs 10 lbs. so 1 Cubic foot contains about 6 gallons. 1 Cubic yard of concrete weighs about 30 cwt. and 18 cubic feet „ „ „ one ton. 1 Radian = 57·29° ϵ = (base of Napierian Logs) = 2·7183. Common Log × 2·3026 = Napierian Log.	

GLOSSARY OF TERMS

AERIAL.—The part of a radiotelegraphic station which is arranged so as to be closely linked with the aether in the neighbourhood of the station; the part, therefore, which is used (in conjunction with the " earth "—q.v.) to transfer the energy of the transmitter to the aether, or—in the case of a receiving aerial—to collect the energy from the aether for use in the receiver. In its usual form it consists of a wire, or system of wires, one end of which is insulated at a certain height above the ground, and the other connected through certain apparatus to earth, or to a " balancing capacity to earth." It is also spoken of as the " Antenna."

AERIAL CIRCUIT.—Starts at the free or insulated end of the aerial and ends with the connection to earth or to the balancing capacity, including all coils and condensers which may interpose, provided that these form part of the direct path for the oscillations from aerial to earth.

AETHER.—The imponderable, elastic, all-pervading medium which cannot be detected by any of our senses, but which is supposed to exist because the Undulatory Theory of Light and of Electro-magnetic Waves (q.v.), based on that supposition, gives a good working hypothesis by which to explain a large number of important phenomena, not only fitting in well with known facts, but even leading to the discovery of new ones.

AUTO-JIGGER.—See Direct Coupling.

ALTERNATING CURRENT.—A current which periodically changes its direction of flow.

ALTERNATOR.—A generator of aiternating current.

ANTENNA.—See Aerial.

APERIODIC.—That which has no definite period of its own. An aperiodic receiver would be one which was ready to respond to all waves, whatever their period might be.

ARRESTER, EARTH.—A small piece of apparatus in the form of a spark-gap presenting a very large sparking-surface and a very short air-gap; largely used by the Marconi Company in their ship stations and elsewhere. It is placed in series with the earth-lead of the transmitter, and from the side of the spark-

gap remote from earth a lead is taken to the receiving apparatus. For received signals the short spark-gap acts as a complete break in the circuit, so that the signals travel along the lead to the receiver; whereas, the moment the transmitting key is pressed, the aerial current breaks down the air-gap, which then acts as a short circuit to earth, but is restored to an insulating condition the moment that transmission ceases. This contrivance, besides doing away with all necessity for an aerial change-over switch, enables the operator to keep the telephones on his head while transmitting, so that the other operator can call his attention if he wishes to ask a question. For this purpose telephone short-circuiting contacts (q.v.) are fitted to the transmitting key. The earth-arrester also fulfils another useful function in keeping the aerial always practically earthed for thunderstorms, etc.

AUTOMATIC TRANSMISSION AND RECEPTION.—(1) *Transmission.* —In this system the actual manipulation of the signalling key, by which the electric waves are sent out in dots and dashes spelling out the message according to the Morse Code, is done by mechanism instead of by the hand of the operator. This elimination of the personal element not only ensures a perfect *regularity* of speed and " spacing," but also allows an enormously *greater* speed to be attained.

(2) *Reception.*—Automatic transmission enables a speed to be attained which is far too high for the human brain to follow and record. To take full advantage, therefore, of automatic transmission, an automatic recorder is necessary. The original " coherer receiver " was an automatic recorder when used in conjunction with a Morse Inker; but it was not suited to high-speed working. The present-day automatic recorder will work up to several hundred words a minute.

ATMOSPHERICS.—Disturbances produced in the receiving circuits, more or less resembling actual signals, caused by electrical action in the atmosphere or in the earth's crust.

BATTERY.—A collection of elements, or units. Thus a simple Voltaic cell would consist of a positive and a negative element in an electrolyte, and a collection of such cells would form an electric battery. Similarly a Leyden jar is a condenser, and a collection of jars would form a battery of condensers.

BLOWER, MOTOR.—A piece of machinery usually in the form of a rotary fan driven by a continuous-current motor, for drawing

in air at atmospheric pressure and delivering it in the form of a high-pressure blast. Used for preventing the formation of an arc.

Bradfield Insulator.—A long ebonite insulator strengthened by a metal core and provided with an asbestos-packed gland. Widely used by the Marconi Co. for leading-in the aerial to the interior of the building; capable of withstanding the high potentials of transmission, and entirely water-tight.

Bus Bars.—This is a single, large lead or connection common to a large number of pieces of apparatus. In W it denotes more particularly the broad common lead on to which the smaller individual leads from the various units of a condenser battery (q.v.) are joined.

Buzzer.—A small piece of apparatus used for the production of feeble oscillations for the purposes of test, etc. It resembles, in one of its forms, the mechanism of an electric bell with the gong and hammer absent.

Buzzer, Tuned.—An ordinary buzzer, with the coils of the electro-magnet shunted by a non-inductive resistance.

Buzzer, Practice.—A combination of a buzzer and a signalling key, arranged in a convenient form on a common base, for the purpose of practising Morse signalling.

Call-Bell.—An arrangement by which incoming signals, and especially signals of distress, may call the attention of the operator even if he is off duty.

Capacity.—The property by which a condenser (q.v.) stores up electrical energy. It is measured by the number of coulombs (quantity of electricity) the condenser will hold when the difference of pressure between the two extreme plates is one volt.

In conjunction with inductance (q.v.), capacity forms an important factor in the production of oscillations.

The effect of capacity on an alternating current is to send on the current in advance of the electromotive force.

Characteristic Curve.—A curve (which may be a straight line) usually drawn with reference to two axes at right angles, showing the variation of a property of a material or of a piece of apparatus when submitted to a gradually increasing influence which produces that variation.

Choking Coil.—A coil of wire wound in such a way as to have great self-induction (q.v.).

Choking Coil, Air-Core Protecting.—A choking coil without any iron core, especially designed to protect the transformer-secondary from high-frequency currents from the oscillating circuits. One such coil is generally put in each lead connecting the transformer to the H.F. condenser. Being without any iron core, these coils have practically no effect on the low-frequency current from the transformer to the condenser, but exert a powerful choking effect on any oscillations which may try to reach the transformer.

Circuit, Closed Oscillating.—A circuit of such a nature that oscillations are possible in it, and so constituted that there is no distinct break of continuity. A spark-gap in series would form such a break, but when once the spark-gap is broken down by a discharge the circuit becomes a closed one. A condenser need not form such a break of continuity, provided its terminal plates are not too far apart; but a condenser in which the plates are very remote—such as the capacity formed by the wire of an aerial as one plate, and the earth as the other—is considered to convert the circuit into an open oscillating circuit.

Circuit, Open or Radiating Oscillating.—See above.

Coherer.—An imperfect contact or collection of such contacts, so arranged that when brought under the influence of the incoming electro-magnetic wave it coheres and allows current from a local battery to pass and make some kind of signal.

Compass, Wireless.—A name given to the Marconi-Bellini-Tosi direction-finder, by which the bearings of a station whose signals are being received can be found by turning a handle over a marked scale. Another type of apparatus is known as the Telefunken Compass.

Commutator.—An arrangement of moving or movable contacts by means of which the direction or path of the current in a system can be changed. Thus in a direct-current dynamo the C changes the alternating current produced in the armature coils into direct current in the leads from the brushes of the commutator; in the induction coil the C reverses the direction of flow of the primary current; in a condenser C the path of the current is changed so as to flow through the condensers either in series or in parallel, or in some combination of the two.

Commutator, Swiss.—A particular form of commutator by which a condenser battery can be arranged in various forms of series-parallel connection.

CONDENSER.—A condenser unit is a system composed of two conducting surfaces placed close together and separated by an insulator, which is called the dielectric. If these two conductors are connected to the terminals of any generator of electricity, positive electricity flows into one of the surfaces and negative into the other. These charges of electricity affect each other through the dielectric, which is put into a state of stress; and the flow continues until this stress exactly balances the pressure applied by the generator. The condenser is then said to be fully charged. For a given impressed voltage or pressure the amount of electricity which must flow before this condition is reached varies with the size of the plates, the distance between them, and with the nature of the dielectric. All these factors, combined into one, form what is known as the capacity of the condenser (q.v.).

CONDENSER, AIR.—A condenser in which the dielectric is air.

COUPLING.—Is the ratio of the mutual induction between two circuits compared with the self-inductance of each circuit. The coefficient of coupling of two such circuits is given by $k = M/\sqrt{L_1 L_2}$. In a coupled-circuit transmitter it is the coupling which governs the interaction of primary and secondary, and the consequent formation of two waves of different wave-length, given by the formulæ $(\lambda_{1 \text{ and } 2})^2 = \lambda^2 (1 \pm \kappa)$, where λ is the wave-length of each circuit taken separately, and λ_1 and λ_2 are the two wave-lengths produced by the interaction.

COUPLING, PERCENTAGE OF.—The fraction representing the coefficient of coupling can be put into the form of a percentage by multiplying by 100.

CRYSTAL DETECTOR.—A form of oscillation detector depending on the fact that certain crystals (*e.g., carborundum*) allow current to pass through them more readily in one direction than in the other; so that they exert a rectifying effect on a train of oscillations, converting the latter into a train of intermittent pulses in one direction, which can be stored up in a condenser or made to agitate the diaphragm of a telephone.

CUT-OUT.—A safety arrangement fulfilling the same function as a fuse (q.v.), but not acting by the fusing of a conductor. Usually a contact is broken by mechanical means as soon as the current reaches a certain value in an electromagnet which controls the release of the contact.

CYMOMETER.—A "wave-measurer." See Wave-meter.

CYMOSCOPE.—A "wave-see-er." See Detector.

Damping.—The process of withdrawing energy from a system, which is moving rhythmically, in such a way as to reduce, little by little, the amount of its movements. Thus a pendulum set swinging freely in air would keep up its motion for a long time, but if the bob were made to pass through a viscous oil, energy would be taken from the pendulum to overcome the friction of the oil and the swings would rapidly become smaller and smaller, and finally be extinguished sooner than if swinging freely in case of air. Similarly if the pendulum is made to do work by driving some clock-work, the swings will rapidly die out unless the spring of the clock-work supplies enough fresh energy.

Damping Factor.—That part of the expression for the logarithmic decrement of an oscillation which is independent of the period of the oscillation (*vide* Decrement).

Decrement, Logarithmic.—A measure of the rate of dying down or decay of an electric oscillation under the influence of damping. The ratio of the max. amplitude of one swing to the max. amplitude of the swing following it is constant, whether the swing be the first, second . . . or last but one; and the Napierian logarithm (q.v.) of this ratio is called the Logarithmic Decrement of the oscillation. Its value depends on the inductance, resistance, etc., in the oscillating circuit, and also on the period of the oscillation.

The general practice is to consider the ratio of one maximum to the maximum following to it, but certain investigators take the ratio of one max. to the next max. *in the same direction.* The decrement per whole period thus obtained is double that of the usual decrement per half-period.

Decremeter.—A piece of apparatus for measuring the logarithmic decrement of an oscillation. The Marconi Decremeter can also be used to measure wave-lengths, capacities, inductances and couplings.

Detector.—An instrument which shows the presence of minute currents, etc. In W, that part of the receiving apparatus which converts the received electromagnetic waves into a form of energy which can be noted visually or by the ear. Most detectors depend on their rectifying (q.v.) action on a train of oscillations, for the rectified current will actuate a telephone receiver or a relay.

Dielectric.—A medium such as glass, ebonite or air through which electrical energy can be transmitted, not by conduction—as

in the case of metals—nor by electrolysis—as in the case of conducting liquids—but by an electrical strain in the medium. Particularly applied to such a medium in connection with condensers (q.v.).

Dielectric Constant.—See Specific Inductive Capacity.

Dielectric Strength.—The property in virtue of which a dielectric is able to stand a powerful electric stress without rupture. It is measured by the pressure (in volts or some other unit) which a thickness of 1 cm. of the dielectric will stand without breaking down.

Diffraction.—The bending of a ray of waves from its normal path in a straight line, on passing "round a corner" (*i.e.*, on passing an opaque obstacle which intercepts part of the ray). The amount of diffraction depends on the wave-length, so that in light, for instance, a spectrum can be obtained by diffraction just as it can be by refraction through a prism; but the relation of the amount of diffraction to the wave-length is exactly opposite to the relation in the case of refraction (q.v.), for with refraction the longer the wave the less is it bent, while in diffraction the greater the wave-length the more the bending.

Direct Coupling.—When one circuit is linked to another in such a way that a portion of one circuit forms part of the other, or in such a way that there is direct electrical connection between the second circuit and a point in the first, then these circuits are said to be direct-coupled. An example of the first condition is provided in the auto-jigger (*vide* Jigger), in which the inductance of the primary circuit is formed of a certain number of turns of the secondary circuit. An example of the second case is where a lead is taken off from a point in the aerial circuit (q.v.) to the detector circuit—as is sometimes done in the case, for instance, of a crystal or valve detector.

Discharger.—That piece of apparatus in the primary oscillating circuit at which the spark or arc, as the case may be, takes place.

Disc Discharger.—A piece of apparatus used by the Marconi Co. for the production of regular trains of slightly-damped waves, giving a clear musical note in the receiving telephones.

Duplex Telegraphy.—A system by which each one of a pair of stations can send a message to, and receive a message from, the other station at the same time.

Earth Connection, or "Earths."—The connection to the upper crust of the earth which in most systems forms the lower

extremity of the aerial system (q.v.). Usually takes the form of a system of metal plates or wires, or a combination of both, more or less deeply buried in the ground near the station.

EFFICIENCY.—A measure of the merits of a piece of apparatus or of a system, with regard to producing the desired effects with minimum expenditure of energy or work.

Most machines and systems are concerned with the transformation of energy of one kind into energy of another kind, and there is always a certain amount of loss in the actual process of transformation. Whatever be the forms of the energy before and after the transformation, they can always be reduced to equivalent values of foot-pounds and their amounts compared; so that the efficiency is measured by the ratio of energy put in to the energy taken out. It is clear that the fewer losses there are in the process of transformation the greater will be the efficiency.

ELECTROLYSIS.—The "splitting-up" of the molecules of a liquid or of a fused solid into positive and negative "ions" by the action of an electric current, these ions moving in opposite directions through the liquid until they meet with the solid conductors which lead the current in to and out from the liquid. To these solid conductors (the "Electrodes") the ions give up their respective charges, with the result that the current appears to be conducted through the liquid (the "Electrolyte") just as if the path had been a metal one; but with attendant chemical changes which are absent in metallic conduction.

ELECTROMAGNETIC THEORY OF LIGHT AND ELECTRIC WAVES.—See Undulatory Theory.

ETHER.—See Aether.

FREQUENCY.—A term used in connection with any form of rhythmical motion or rhythmical change, denoting the number of complete movements or changes in a given time—usually a second.

FREQUENCY, HIGH AND LOW.—The term low frequency was originally applied to alternating currents produced by machines, of the order of from 25 to perhaps 1,000 periods per sec., while the term high frequency was reserved for those very rapid currents produced by the discharge of a condenser, and used in radiotelegraphy, medical electricity, and elsewhere; such frequencies being of the order of millions per sec. Now, however, with the development of long-distance radiotelegraphy, frequencies as low as 20 or 30 thousand periods per sec. are being

produced by condenser-discharge, while, on the other hand, alternating-current machines have been designed to give similar high frequencies. The line of demarcation, therefore, between high and low frequencies has become less definite, but in general a frequency measured in tens or hundreds of periods per sec. may be called a low frequency, while one measured in thousands or millions per sec. may be called a high frequency.

FUNDAMENTAL.—The fundamental note, swing, or oscillation of a system capable of rhythmical motion or change is the one which fits in with the formula giving the time-period of the system in terms of those of its properties which affect that period. Thus in an electrical oscillating circuit the time-period is fixed by the amount of inductance, capacity, and resistance in the circuit, and the fundamental wave of such a circuit would be a wave of that time-period.

Such a circuit, however, is capable of resonance to certain other waves, called "Harmonics," whose frequencies bear a certain definite relation to that of the fundamental.

Thus in radiotelegraphy the first harmonic of an aerial has a frequency three times as great as that of the fundamental; the second harmonic, five times as great, and so on.

FUSE.—A short piece of conducting material, usually in the form of a wire or strip of metal with a low fusing-point, introduced in series with an electric circuit. If the current in this circuit rises for any reason above a certain safe value, the conductor melts and thus breaks the circuit, preventing the excessive current from doing damage to the apparatus. *Vide* "Cut-Out."

GALVANOMETER.—An instrument for indicating and measuring an electric current (usually of small magnitude).

GALVANOMETER, STRING OR EINTHOVEN.—An exceedingly sensitive galvanometer, suitable for indicating received signals in wireless, in which the moving-part is a fine stretched conducting string.

HARMONIC.—See Fundamental.

HARMONIC CURVE.—See Sine-wave.

HIGH-FREQUENCY ALTERNATOR.—See Frequency, High and Low.

HIGH-FREQUENCY RESISTANCE.—The resistance offered by conductors to the passage of high-frequency currents. Owing to the fact that such currents confine themselves to the skin of the conductor, a much smaller amount of material is provided for the

passage of the current than would be the case for a continuous current, which distributes itself uniformly throughout the whole cross-section of the conductor, or for a low-frequency current, in which distribution is not uniform but equivalent to leaving only a small central portion inactive. The high-frequency resistance of a conductor is therefore considerably greater than its ordinary resistance.

HYSTERESIS.—A "lagging-behind"—the lagging of an effect behind the cause producing it; generally due to friction of some kind, molecular or otherwise.

Particularly applied to the lagging of the magnetisation of a substance such as iron behind the magnetising force, by which tne magnetising force may reach its maximum value some time before the resulting magnetisation reaches its maximum, and, on the other hand, the iron may still have some magnetism left when the force producing it has been reduced to zero.

Similarly, the stress in the dielectric (q.v.) of a condenser (q.v.) lags behind the changes of electrical pressure producing the stress. In both these cases, if the cycle of change is repeated many times per second, the molecular friction producing the hysteresis results in the production of heat.

INDUCTANCE.—The property of an electric circuit, by virtue of which it tends to oppose any change in the value of the current flowing therein, the opposition being effected by the production of an electromotive force in such a direction as to lessen the change producing it.

Inductance is thus comparable with inertia in mechanics, which tends to oppose any change in the motion of a body, and produces a force in such a direction as to lessen the change.

The effect of inductance on an alternating current is to cause the current to lag behind the electromotive force.

In conjunction with capacity (q.v.) inductance forms an important factor in the production of oscillations.

INDUCTANCE (concrete sense).—A circuit, or part of a circuit, designed so as to have considerable inductance, and made use of for that property, is known as an inductance coil, or an inductance.

INDUCTION COIL.—A piece of apparatus which makes use of the phenomena of induction to transform continuous current of comparatively low voltage to an intermittent current of high voltage.

Inductive Coupling.—When two circuits are linked together in such a way that there is no direct electrical connection between them as in the case of direct coupling (q.v.), the only linking being provided by the mutual induction between the circuits, they are said to be inductively coupled.

Interference.—The inter-action of two waves of different frequencies, or of two waves of the same frequency but different phase, acting in the same circuit; resulting in the formation of points called "Nodes" where the resultant energy is zero, and "Antinodes," or "Loops," where it is at a maximum. This phenomenon is particularly obvious in acoustics, and can be demonstrated beautifully in light; but it is also of great importance in radiotelegraphy. See also Loop.

Interference (in reception).—The introduction of undesired signals, either from other stations or from atmospheric discharges, into a receiver which is engaged in the reception of a message.

Interrupter.—An arrangement for breaking up a continuous current into a succession, more or less rapid, of pulses. Used particularly in connection with the induction coil (q.v.). Has various forms, of which the commonest is the hammer-break, in which the current itself provides (through its magnetising powers) the force required for working the interrupter; the electrolytic interrupter, in which the current interrupts itself by forming and breaking-down, in rapid succession, globules of insulating gas at a finely pointed electrode (see Electrolysis); and the mercury, or turbine, interrupter, driven by an electric motor, in which the path of the current along a jet of mercury is constantly being cut through by a rotating toothed plate.

Ionisation.—See Electrolysis. In a liquid which conducts electricity, some at least of the molecules are normally split up into their constituent "ions" and there is a constant interchange of partners going on between the ions of one molecule and their neighbours. When, therefore, an electromotive force is applied, tending to force a current through the electrolyte, none of this force has to be applied in order to break up the molecules into their ions. However small, therefore, this force may be, it will always have ions at its disposal to carry the current, though the magnitude of the current will depend, of course, on the magnitude of the E.M.F. applied. So the smallest difference of potential will always force a small current through an electrolyte; and an electrolyte is in a permanent state of "ionisation." When, however, we have to deal with conditions through a gas, the condi-

tions are different. A gas, like a liquid, can only conduct through the medium of ions, and in gas under ordinary conditions—air, for instance, in a spark-gap before a discharge—there is practically no ionisation. Air under such conditions behaves, therefore, as an insulator, and the potential difference has to reach a very high value before the molecules break up into ions and allow the spark to pass. The current, passing in the form of a spark, produces a great amount of "ionisation," and the resistance of the gap becomes quite low.

JIGGER.—A special form of potential transformer designed for high-frequency (oscillating) currents.

JIGGER, TRANSMITTING.—The oscillation transformer used in the transmitting apparatus for transferring the energy of the primary circuit to the aerial circuit. The comparatively low potential of the primary current is transformed to a potential which increases up the aerial and reaches a very high value at the free insulated end of the latter.

JIGGER, RECEIVING.—The oscillation transformer used in the receiving apparatus for transferring the energy collected by the aerial circuit to the detector circuit.

KEY, MANIPULATING KEY, OPERATING KEY.—The instrument which, worked by the hand of the operator, causes the transmitter to send out signals in the form of the Morse Code.

KEY, HIGH-TENSION TRANSMITTING.—An arrangement by which the transmitting circuit is made and broken by a switch in the high-tension leads of the transformer, controlled by the ordinary manipulating-key. Usually the primary current is made and broken for signalling purposes, but on large stations, where the primary current is too large to control by a key with ease and rapidity, the H-T key is employed, since the high-tension currents are smaller.

LAMP, TUNING.—A small, low-voltage incandescent-filament lamp arranged so that it can take a small fraction of the oscillating current induced in the earth-lead of the transmitter. The amount of glow produced in this lamp when the transmitter is in action is an indication of the total current in the earth-lead, and as this depends on the accuracy of syntonisation between the primary and secondary the lamp can be used for the purpose of tuning these circuits; for if both an increase and a decrease in the wave-length of the aerial circuit produce a less brilliant glow the two circuits must be in tune.

Leyden Jar.—A modification of the original form of the first condenser (q.v.) ever discovered. Still used sometimes on account of its simplicity and strength. It consists of a glass jar with its bottom and part of its sides covered inside and outside with tin-foil, connection with the inside foil being made by a rod passing through the stopper and spreading out in the interior of the jar in the form of wire springs which press against the tin-foil.

Loop of Potential (also called Anti-node of Potential).—A point of maximum potential in a circuit or portion of a circuit along which the potential is gradually rising or falling. When an oscillation travels up an aerial, it is reflected back from the free insulated end, and the reflected wave, interfering with the original wave (see Interference) produces what is called a stationary wave in the aerial. This results in a production of different values of potential at different points along the aerial circuit, the value of the potential increasing and decreasing in the form of a wave-curve along the circuit. If the circuit is vibrating to its fundamental (q.v.), the potential starts with a zero value at the earth connection and increases all the way along the aerial till it reaches a maximum at the free end. If it is vibrating to a harmonic, there will be one or more points along the aerial circuit where the potential is zero. These points, together with the zero point at earth, are called the nodes of potential, and their antitheses, the points of maximum potential, are called the anti-nodes or loops of potential. Whether the aerial circuit is vibrating to its fundamental or to a harmonic, if it is vibrating freely it will always have a node of potential at the earth and an anti-node or loop at the free end. A node of potential is also an anti-node of current, and *vice versâ*.

Magnetic Detector, Marconi's.—A detector (q.v.) of oscillations depending on the effect of these on the hysteresis (q.v.) of soft iron.

Magnetic Key, Gray's.—An instrument used in conjunction with the ordinary key (q.v.) to facilitate the use of the latter when dealing with fairly large alternating currents. The contacts of the magnetic key short-circuit those of the hand key directly this is pressed, and only break the short-circuit when the alternating current is passing through its zero value. Hence the damage which might be done to the contacts owing to arcing is avoided.

Mast, Steel Sectional.—A type of mast built up of hollow steel sections of semi-circular shape, after a system which enables

it to be erected to great heights, such as 450 ft., without the use of any kind of scaffolding.

MICROPHONE.—A sound-magnifier, by which very faint sounds, such as those produced by a fly's feet, can be rendered audible, or by which comparatively loud sounds—such as those of a person speaking into a telephone—can be made to produce greater effects than would otherwise be the case.

MICROMETER SPARK-GAP.—A term given in radiotelegraphy to a small, delicately adjustable spark-gap, used as a protecting device for receivers, etc., to protect them against atmospheric discharges and other undesired influences. Somewhat similar in action to the earth-arrester (q.v. under Arrester).

MORSE INKER.—An apparatus for recording the short and long signals of the Morse Code in the form of short and long ink-marks made by an inked wheel on a travelling strip of paper.

MULTIPLE TRANSMISSION AND RECEPTION.—A system by which one station can send two or more messages simultaneously to two or more other stations, or receive similarly from them. In conjunction with duplex (q.v.) it enables a station to receive messages from two or more stations, while at the same time sending messages to them.

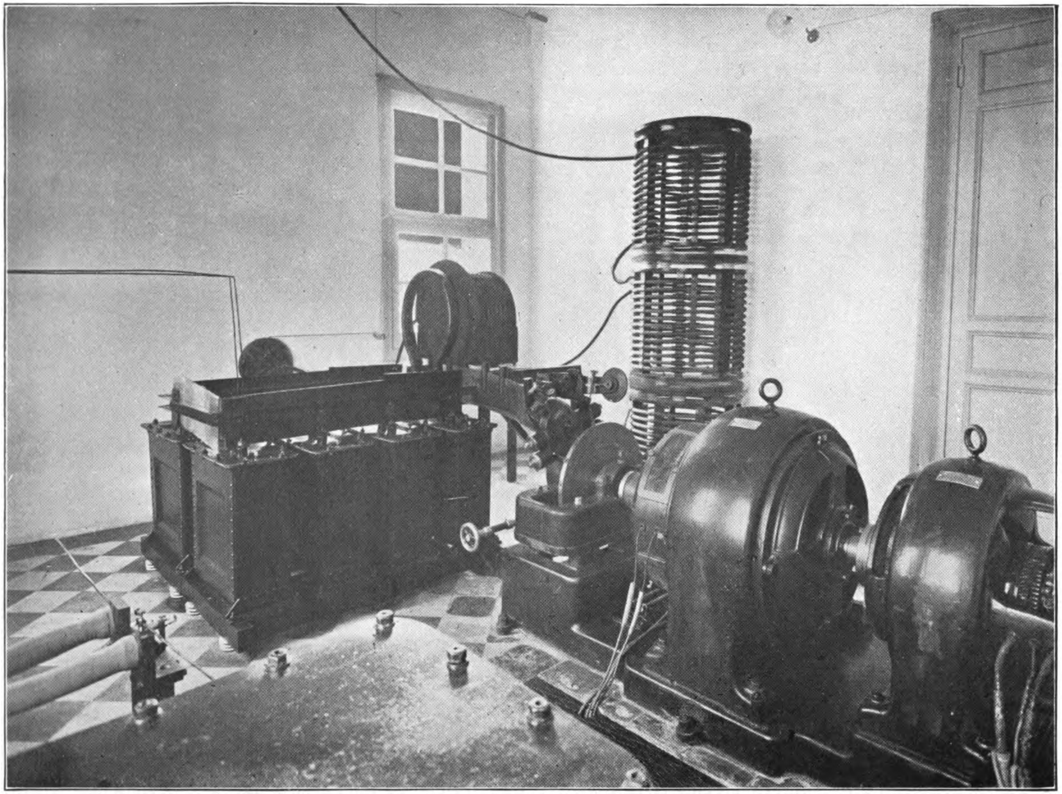
NAPIERIAN LOGARITHMS.—A scientific system of logarithms to the base ϵ, whose value is 2·7183 approx. Also called Hyperbolic or Natural Logarithms, in contra-distinction to the Logs to base 10, which are termed Common or Brigg Logs.

NODE.—See Loop.

NON-INDUCTIVE SHUNT.—A shunt (*i.e.*, an alternative path) of such a nature as to possess little or no inductance. Often made by doubling an insulated wire into a loop, and treating the double wire thus formed as one wire, which is then wound into a small coil beginning at the looped end.

NOTE TUNING.—Syntonisation of the receiver to the frequency of the wave-trains instead of to the frequency of the waves themselves. The rapidity with which one train follows the other determines the note of the sound produced in the receiver, which may by various methods be made sensitive to one particular note in preference to others.

OSCILLATIONS, ELECTRIC.—Alternating currents of high frequency (q.v.) such as are produced by the discharge of a condenser through a circuit whose resistance does not exceed a certain value in comparison with the inductance and capacity.



Generating Plant at Aranjuez (Madrid) Station

[To face page 428

Oscillations, Free and Forced.—An oscillation is said to be "free" when the circuit in which it takes place is suited to it, *i.e.*, when the oscillation has the same frequency, on its own account, as that of the fundamental (q.v.) or of one of the harmonics (q.v.) of the circuit. It is said to be "forced" when the circuit in which it takes place is not suited to it.

Period.—The period of any system undergoing rhythmical change signifies one complete cycle of change, at the end of which the system is ready to start again on a cycle similar in nature and sense (or "direction").

Periodic Time.—The time taken by one complete period.

Phase.—An alternating or oscillating current, in performing a complete alternation or oscillation, passes through two complete series of changes, each of the two series being of the same nature (though not necessarily of the same magnitude), *but in the opposite sense,* or, as it is commonly spoken of, in the opposite direction. The phase of such a current at any moment of time denotes what part of the two series of changes has been reached by the current at that instant.

Plain Aerial.—An early form of transmitter in which the spark-gap producing the oscillations was placed directly in series with aerial and earth, so that the only condenser in which the energy of the transmitter could be stored was the capacity of the aerial to earth.

Similarly, the term is sometimes applied to the receiving circuit when the detector is placed directly in series with the receiving aerial and earth.

Potentiometer.—An erroneously-named piece of apparatus used for a delicate adjustment of potential between two points. Consists essentially of a high resistance put "in shunt" across a source of current, a sliding-contact being provided from which a lead can be taken off from any point along the potential gradient produced along the resistance.

Protecting Devices.—Arrangements by which it is ensured that apparatus shall not have its insulation, etc., damaged, or its working interfered with, by undesired influences from other circuits or elsewhere. Examples of such influences are: atmospheric discharges and induced currents from the transmitter, in the case of receiving apparatus; the same induced currents, and oscillations conducted back from the high-frequency circuits, in the case of

transmitting apparatus. See article on "The Marconi System" in this volume.

QUENCHED SPARK.—A form of spark which, owing to the nature of its discharger, extinguishes itself rapidly after allowing a few oscillations to pass.

QUENCHED SPARK SYSTEM.—A system of transmission using a quenched spark in the primary circuit. The object aimed at is that as soon as the primary circuit has given up all its energy to the aerial circuit, the spark becomes extinguished, so that there is no longer a closed-circuit primary to re-act on the secondary, thus producing two frequencies in the circuits.

RADIATION.—The transference of energy, whether in the form of light or heat, or in that form which is utilised in wireless telegraphy, by electromagnetic waves through the æther. See Undulatory Theory.

RADIATION RESISTANCE.—The rate at which the oscillations set up in a circuit decrease and die away depends on the losses experienced by each oscillation. (See Damping and Decrement.) These losses are made up of losses due to the production of heat in the circuit, owing to the resistance of the latter, and losses due to the transference of energy to other circuits.

In the case of an aerial the losses are made up of the heat-losses in the aerial and earth—"joulean losses"—and the losses due to the radiation of energy in the form of ætheric waves. If the power of radiating were removed from the aerial, the decrease in damping caused by the removal of radiation losses could be made up for by adding more resistance to the aerial circuit, thus increasing the joulean losses.

The amount of resistance which would have to be added in order to bring up the total losses to their old value is clearly a measure of the radiating powers of the aerial, and is called the Radiation Resistance.

RECTIFIER.—An apparatus for converting alternating or oscillating currents into continuous current, or into pulses of unidirectional current.

REFRACTION.—A change in direction of a wave of any kind brought about by its entering a medium in which its velocity is different to the velocity in the medium which it is leaving. If the wave enters the second medium in a direction normal to the surface of demarcation between the two media, the direction of the wave is unchanged, but if it enters at an angle to the sur-

face, it is bent or refracted either towards or away from the normal at the point of entry, according as the second medium gives a lower or higher velocity than the first—*e.g.*, a ray of light entering a glass prism.

RELAY.—An apparatus by means of which a current, too small to perform the required work, is made to turn on and off a larger current, which performs the work under the control of the small current.

RESONANCE.—The production of vibrations in a body or a circuit by the action of a periodic force which has the same period as the natural period of the body or circuit. Under these conditions, the series of impulses produced by the periodic force, following one another in regular succession, find themselves so "fitting in" with the effects produced by their predecessors that one impulse helps and strengthens the other.

See Fundamental, Period.

ROOM, OPERATING.—The room in a radiotelegraph station wherein the telegraphist or operator works in sending or receiving the messages.

ROOM, TRANSMITTING.—The room containing the actual transmitting apparatus, the operation of which is controlled from the operating room.

ROOT-MEAN-SQUARE VALUE.—R.M.S. value of an alternating or oscillating current is the value given by the square root of the sum of the squares of the successive values of the current throughout the half-period.

In a current of strict sine-wave shape (sinusoidal current) the R.M.S. value is equal to the maximum current multiplied by ·707. The R.M.S. current is also called the Effective Current.

The above also applies to the R.M.S. value of Potential.

RUHMKORFF COIL.—The name given to the original induction coil for the production of small currents of very high voltage from larger currents of low voltage. The ancestor of the "trembler" coil used for motor-car ignition purposes.

SELECTIVITY.—The property of a receiving apparatus by virtue of which it can select or pick out the waves from the station which it wants to "receive," to the exclusion of all other waves from other stations or from the atmosphere.

SELF-INDUCTION.—The self-induction of a part of a circuit in which an alternating or oscillating current is flowing, is the effect produced on the current by its own action on that part of the

circuit, due to the inductance (q.v.) inherent in that part from its nature and shape.

Shock-Excitation.—A name given to the method of exciting oscillations in the aerial circuit by a sudden and very short transference of energy from another circuit. See Quenched Spark.

Shunt.—An alternative path for an electric current.

Sine-Wave, Sinusoidal Wave.—A wave of such a kind that the rhythmical changes which constitute it can be represented by a particular form of smooth curve known as a sine-curve; the characteristic of this being that the values represented by different points on the curve are always proportional to the sines of an angle which is increasing uniformly throughout the period and which is proportional to the times at which those points on the curve are reached. In other words, the ordinates of a sine-curve are proportional to the sines of an angle which is itself proportional to the corresponding abscissæ.

The sine-curve is also known as a Harmonic Curve.

The alternating current from certain alternators approaches very nearly to a perfect sine-wave; oscillating currents as a rule are not sinusoidal.

Skin-Effect.—See High-frequency Resistance. ...

Spark-Micrometer.—A tool or instrument for the accurate determination of the length of a spark-gap. (c.f. and contrast Micrometer Spark-gap.)

Specific Inductive Capacity.—The S.I.C. of a medium is the ratio of the capacity of a condenser, having the medium as a dielectric, to the capacity of the same condenser with air as the dielectric.

Starter, Motor-.—An arrangement of resistances and contacts for regulating the entry of current into the field- and armature-coils of a motor when starting up from rest; usually including also arrangements by which the current is cut off entirely when anything abnormal takes place in the circuit.

Syntony and Syntonisation.—The adjustment of one circuit to another, or of one transmitter taken as a whole to one receiver taken as a whole, in such a way that the time-periods are the same throughout the system; so that waves possessing a time-period different to this will produce little or no effect on the system. (See Oscillations, Free and Forced; Resonance; Period, and Selectivity.)

TAPPER.—A small vibrating hammer used for restoring certain forms of coherer (q.v.) to a condition of non-conductivity on the cessation of signals.

TELEPHONE-SHORT-CIRCUITING-CONTACTS.—An arrangement of two small platinum contacts mounted on the same base as the manipulating key (q.v.) and so disposed that the action of pressing this key automatically closes these contacts. The contacts are connected directly across the leads to the telephone receiver, with the result that when the key is pressed in order to send out a signal from the transmitter they short-circuit the telephones a little before the actual key-contacts close and the signal is sent.

In conjunction with the arrester (q.v.) this arrangement enables the operator to keep the telephones on his head while in the act of transmitting, without experiencing the troublesome noises which would otherwise be induced in the telephones.

TELEPHONE TRANSFORMER.—A small transformer used in connection with a telephone of low resistance in conjunction with a high-resistance detector such as the valve or crystal (q.v.).

TELEPHONE CONDENSER.—A condenser, usually variable in three steps, placed in shunt across the telephone receiver. Suitable adjustment of this condenser improves the quality of the sound produced by the signal, rendering it more audible and more distinguishable from atmospherics.

TRAIN OF WAVES.—The group of oscillations sent out from the aerial at every discharge of the primary circuit. The number of waves in a train obviously depends on the decrement or rate of decay; while the number of trains per second determines the nature of the musical sound received by the ear—*i.e.*, the frequency or pitch of the note.

TRANSFORMER.—Usually refers to a potential transformer—*i.e.*, an apparatus for changing a current of electricity at one potential or voltage into a current at a different potential or voltage. A " step-up " T converts the current to a higher voltage, a " step-down " T to a lower voltage.

Transformers may take the form of a piece of machinery with a rotating armature, but the word is usually applied to the " static " transformer which has no moving part and which depends on the use of alternating current (q.v.). The induction coil is a form of static transformer which works with direct current split up mechanically into pulses of uni-directional current; or it can be used with alternating current by suppressing the interrupter (q.v.).

TREMBLER.—A particular form of interrupter (q.v.) resembling a hammer-break on a small scale, and largely used on small induction coils such as are employed for motor-ignition purposes.

TUNER, MULTIPLE.—A piece of apparatus brought out by the Marconi Co. and in general use at all their ship-stations and elsewhere. It is used in conjunction with the Magnetic Detector (q.v.) and, when thus combined, provides in a compact and convenient form a complete receiving apparatus, with all the requirements and niceties for accurate syntonisation and selectivity, together with the power of rendering the system non-selective at will, so as to be on the "look-out" for any possible signals.

TUNING.—See Syntony. Also see Note-Tuning.

TUNING, FLAT AND SHARP.—Tuning is said to be *sharp* when a small change of time-period in a circuit produces a marked effect on the strength of the currents which are being imposed on the circuit, and *flat* when this is not the case.

UNDAMPED WAVES.—A train of undamped waves is one in which the amplitude of each successive wave is equal to that of the wave preceding and following it. Such a train, therefore, has no tendency in itself to decay and die away, and its decrement is zero.

A truly undamped wave should have a pure sinusoidal form.

UNDULATORY THEORY, OF LIGHT AND OTHER RADIATION.—The theory which forms the basis of modern ideas with regard to light, heat, and electric phenomena.

In its original form, and applied to light, it was suggested in the seventeenth century by Huyghens, who maintained that light consisted of waves of some sort starting out from the luminous body. The whole of space was supposed to be filled with an imponderable, unsubstantial substance, which nevertheless had to possess perfect elasticity; and the luminous body, by the vibrations of its atoms, was supposed to send out waves of vibration in all directions through this substance, one atom of which would hand on its vibration to the next, and so on. This idea, though it explained all the known phenomena of light, led to certain difficulties; for if the atoms of the luminiferous æther—as this all-pervading substance was termed—were actually set into motion by the waves, certain results would be produced which are contrary to known facts.

The theory as it stood was modified by Clerk Maxwell and extended by him to foreshadow the actual discovery of the waves

now used in radiotelegraphy. According to his theory—known as the Electro-magnetic Theory of Light and Electric Waves—the vibrations consist not in the change in position of the æther particles, but in a periodic alteration of the electrical and magnetic condition of the æther.

The theory, thus modified, has none of the old objections, and it has been supported by every fresh discovery which has been made since it was adopted. It led, for instance, to the discovery by Hertz of the electric waves which were the small forerunners of those now used for Marconi telegraphy.

Summed up, the theory states that the æther conveys every kind of radiation *with the same speed* in the form of periodic electro-magnetic changes in the condition of the æther from point to point; that the kinds of radiation include light waves of every colour, radiant heat waves, the waves which affect the photographic plate, and the waves used in Marconi telegraphy, and that these different waves, through producing such diverse effects, only differ from one another in the time taken for a complete period.

The theory of electrons, more modern still, agrees with the older theory and defines more precisely what is meant by the electro-magnetic changes.

VALVE, VACUUM, OR FLEMING VALVE.—A form of detector depending on the fact that in an exhausted vessel the space between a glowing filament and a cool, insulated conducting surface near it will allow current to pass from the cool surface to the filament, but not in the reverse direction. That is to say, the filament is continually sending off negative electrons, which will therefore serve to conduct electricity in the negative sense from the filament to the surface, but not *vice versâ*. As a result, such an arrangement can be used as a rectifier (q.v.) for received oscillations, and thus as a detector (q.v.).

WAVES, WAVE-MOTION, WAVE THEORY.—See Undulatory Theory, etc.

WAVE-LENGTH.—The actual distance between any point in a wave and the corresponding point in the wave immediately following or preceding it, in the same train.

WAVE-METER.—An instrument for measuring the wave-length and frequency of an electro-magnetic wave.

X.—The name given to signals generated by atmospheric disturbances or changes in the earth's magnetic condition.

X-STOPPERS.—Arrangements for eliminating the effects of atmospheric disturbances on the receiving circuits.

DICTIONARY OF TECHNICAL TERMS

English.	French.	Italian.	Spanish.	German.
Accumulator batteries	Batterie d'accumulateurs	Batterie di accumulatori.	Acumuladores, Baterias de	Accumulatoren Batterie
Aerial, horizontal	Antenne horizontale	Antenna orizzontale	Antena horizontal	Horizontaler Luftleiter
Aerial, receiving	Antenne de réception	Antenna di ricezione	Antena de recepcion	Empfangsdraht
Aerial, "star"	Antenne en étoile	Antenna stellata	Antena en estrella	Sternformiger Luftleiter
Aerial, transmitting	Antenne d'émission	Antenna di trasmissione.	Antena de transmission	Geberdraht (Sendeluftleiter)
Aerial, umbrella	Antenne en parapluie	Antenna a forma di ombrella	Antena de paragua en forma	Schirmnetz
Alternator	Alternateur	Alternatore	Alternador	Wechselstromumformer
Ammeter, a.c.	Ampèremètre pour courant alternatif	Amperometro per corrente alternata	Amperimetro, c.a.	Wechselstromamperemeter
Ammeter, d.c.	Ampèremètre pour courant continu	Amperometro per corrente continua	Amperímetro, c.c.	Gleichstromamperemeter
Ammeter, hotwire	Ampèremètre à fil chaud.	Amperometro a filo caldo	Amperímetro térmico	Hitzdrahtamperemeter
Ammeter, moving coil	Ampèremètre d'Arsonval	Amperometro a bobina mobile	Amperímetro de bobina movil	D'Arsonvalscher Amperemeter
Antenna.	Antenne	Antenna	Antena.	Luftleiter (Antenne)
Antenna, horizontal extension of	Branche horizontale de l'antenne	Fili orizzontali dell' antenna	Antena, Prolongación horizontal de la	Horizontale Verlangerungsdrahte des Luftleiters
Antenna, T-shaped	Antenne en T.	Antenna a forma di T.	Antena en forma de T.	T. formige Antenne
Antenna, extended T-shaped	Antenne en T. à branches horizontales prolongées	Antenna a forma di T. allungata	Antena en forma de T. prolongada	Verlangerte T. Luftleiter
Apparatus, receiving	Appareils de réception	Apparecchi di ricezione	Aparatos receptores	Empfanger
Apparatus, transmitting	Appareils de transmission	Apparecchi di trasmissione	Aparatos transmisores	Sender
Arrester, earth terminal	Eclateur de mise à terre	Morsetto di terra scaricafulmine	Estallador de toma de tierra	Unterbrochener Erdanschlusz
Arrester, lightning	Parafoudre	Dispositivo scaricafulmine	Pararrayos	Blitzschutz
Atmospherics	Perturbations atmosphériques	Perturbazioni atmosferiche	Perturbaciones Atmosféricas	Luftstoerungen
Battery of Leyden jars	Batterie de bouteilles de Leyde	Batteria di bottiglia di Leida	Bateria de Botellas de Leyden	Batterie Leydener Flaschen
Bell, call-	Sonnerie d'appel	Campanello di chiamata.	Timbre de Llamada	Lockklingel
Blower, electric motor	Soufflerie à moteur électrique	Ventilatore ad azionamento elettrico	Motor soplador *or* Ventilador eléctrico	Geblaeser mit Elektrischen Antrieb
Busbars, main-	Barres omnibus principales	Barre collettrici principali	Barras colectoras principales	Haupt Sammelschienen
Building, station-	Bâtiment du poste radiotélégraphique	Fabbricato della stazione	[illegible]	[illegible]

Buzzer, practice . .	Vibrateur d'apprentissage	Cicala per la pratica della ricezione a udito	Zumbador para practi .	Übungssummer
Capacity . . .	Capacité . . .	Capacità . . .	Capacidad . . .	Aufnahmefahigkeit
Cart, radiotelegraph .	Voiture radiotélégraphique	Carro radiotelegrafico .	Carro de radiotelegrafía .	Funkenkarren
Change of connections for receiving	Commutation pour la réception	Commutazione per ricezione	Cambio de conexiones para la recepción	Umschaltung auf Empfangen
Change of connections for transmitting	Commutation pour la transmission	Commutazione per trasmissione	Cambio de conexiones para la transmisión	Umschaltung auf Senden
Chokes, air core protecting	Bobine de réactance sans noyau de fer	Bobine di protezione a nucleo d'aria	Bobinas de reactancia, protectoras, de núcleo de aire	Impedanzsphulen fur hohe Frequenz mit Luftkern
Choking coil . . .	Bobine d'impédance .	Rocchetto d'autoinduzione	Bobina de reactancia .	Drosselspule
Circuit breaker and closer.	Disjoncteur et conjoncteur Automatique . .	Interruttore . . .	Interruptor con apertura y cierre automáticos	Strom-unterbrecher Strom-schliesser
Circuit, closed oscillating .	Circuit oscillant fermé .	Circuito oscillante chiuso.	Circuito oscilante cerrado	Geschlossener Erregerkreis
Circuit, intermediate .	Circuit intermédiaire .	Circuito intermedio .	Circuito intermedio .	Zwischenkreis
Circuit, open radiating .	Circuit radiant ouvert .	Circuito radiante aperto .	Circuito radiador abierto	Offener Strahlungskreis
Circuit, oscillatory . .	Circuit oscillatoire . .	Circuito oscillante . .	Circuito oscilante . .	Schwingungskreis
Circuit, oscillating transmitting	Circuit oscillant d'émission	Circuito oscillante trasmittate	Circuito oscilante transmisor	Sender Erregerkreis
Coherer	Cohereur	Ricevitore a coherer .	Cohesor	Fritterempfanger
Coil, syntonising . .	Inductance de syntonisation	Rocchetto di sintonizzazione	Bobina de sintonización .	Abstimmspule
Commutator . . .	Commutateur . .	Commutatore . .	Conmutador . . .	Stromwender
Condensers . . .	Condensateurs . .	Condensatori. . .	Condensadores . .	Kondensatoren
Condenser, adjustable .	Condensateur règlable .	Condensatore regolabile .	Condensador variable .	Variabler Kondensator
Condenser, adjustable disc	Condensateur à disque .	Condensatore a disco regolabile	Condensador de disco, variable	Drehkondensator
Condenser, aerial tuning .	Condensateur de syntonisation d'antenne	Condensatore per la sintonizzazione dell' antenna	Condensador de sintonización de la antena	Kondensator zur Luftleiterabstimmung
Condenser, air . .	Condensateur à air .	Condensatore ad aria .	Condensador de dialéctrico de aire	Luftkondensator
Condenser, calibration .	Condensateur étalon .	Condensatore per tarature	Condensador para calibración	Eichungskondensator
Condenser, circuit . .	Circuit du condensateur.	Circuito del condensatore	Condensador, Circuito de	Kondensatorkreis
Condenser, intermediate circuit	Condensateur du circuit intermédiaire	Condensatore per il circuito intermedio	Condensador del circuito intermedio	Kondensator im zwischenkreis
Condenser, secondary circuit	Condensateur du circuit secondaire	Condensatore per il circuito secondario	Condensador del circuito secundario	Kondensator im secundärkreis
Condenser, short wave .	Condensateur de raccourcissement	Condensatore per onda corta	Condensador de onda corta	Verkurzungskondensator
Condenser-system . .	Système de condensateur	Syste Condema dinsatori	Sistema de Condensadores	Kondensatorsystem

Dictionary of Technical Terms—*Continued*

ENGLISH.	FRENCH.	ITALIAN.	SPANISH.	GERMAN.
Condensers, test-tube	Tube d'essai pour condensateurs	Condensatori tubolari-campione	Tubo para erisayo de condensadores	Kondensator prüfröhre
Condensers, variable	Condensateurs réglables	Condensatori variabili	Condensadores variables.	Variablerkondensatoren
Coupling	Couplage	Accoppiamento	Acoplamiento	Kopplung
Couplings, flexible and insulating	Mauchons d'accouplement souples et isolants	Accopiamenti elastici ed isolanti	Acoplamientos flexibles y aisladores	Biegsame und isolierende verbindungen
Current, alternating	Courant alternatif	Corrente alternata	Corriente alterna	Wechselstrom
Current, direct	Courant continu	Corrente continua	Corriente contínua	Gleichstrom
Current, primary alternating	Courant alternatif primaire	Corrente alternata del circuito primario	Corriente alterna primaria	Primaer Wechselstrom
Current, secondary alternating	Courant alternatif secondaire	Corrente alternata del circuito secondario	Corriente alterna secundaria	Sekundaer-Wechselstrom
Cut-out, automatic	Interrupteur automatique	Interruttore automatico	Interruptor automático	Selbstunterbrecher
Cymometers	Cymomètres	Cimometri	Cimómetro	Wellenmesser
Damper	Sourdine	Sordina	Amortiguador	Dämpfer
Damping, high	Amortissement élevé	Forte smorzamento	Amortiguamiento, Gran	Grosse Dämpfung
Decremeter	Décrémètre	Decrimetro	Decrémetro	Dekremeter (Dampfungsmesser)
Detector, contact	Détecteur à contact	Rivelatore di onde a constatti	Detector de contacto	Kontaktdetektor
Detector, crystal	Détecteur à cristal	Rivelatore di onde a cristallo	Detector de cristal	Krystalldetektor
Detector, Fleming valve	Récepteur à valve d'oscillation " Fleming "	Rivelatore di onde con valvola di Fleming	Detector de Válvula, Fleming	Prof. Fleming's Valve-Empfanger
Detector, magnetic	Détecteur magnétique	Rivelatore di onde magnetico	Detector magnético	Marconi-Magnetdetektor
Detector, mineral	Détecteur à mineral	Rivelatore di onde a sostanze minerali	Detector mineral	Mineraldetektor
Detector, recording	Détecteur enregistreur	Rivelatore di onde registratore	Detector registrador	Registrierende Detektor
Detector, thermo-electric	Détecteur thermo-éléctrique	Rivelatore di onde termoelettrico	Detector termoeléctrico	Thermo-elektrischer detektor
Detector, wave	Détecteur d'ondes	Rivelatore di onde.	Detector de ondas	Wellenanzeiger
Discharger, disc, high-speed	Eclateur à disque à grande-vitesse	Scaricatore a disco ad alta velocitá	Descargador de disco de gran velocidad	Schnell rotierende Scheibenfunkenstrecke
Discharger, disc, smooth	Eclateur à disque uni	Scaricatore a disco a con-	Estallador de disco liso	Rotierende Scheibenfunkenstrecke-glatt

spark		micrometrica		
Duplex telegraphy	Télégraphe duplex	Telegrafia duplex	Telegrafía duplex	Duplex Telegraphie
Earth connection	Connexion de terre	Messa a terra	Conexión de tierra	Erd Verbindung
Energy	Energie	Energia	Energía	Energie
Frequency, high	Haute fréquence	Alta frequenza	Frecuencia, alta.	Hochfrequenz
Frequency, low	Basse fréquence	Bassa frequenza	Frecuencia, baja	Niedfrequenz
Frequency meter	Fréquencemètre	Frequenziometro	Frecuencímetro	Frequenzmesser
Fuse	Fusible.	Fusibile	Fusible.	Schmelzeinsatz
Generating plant	Générateur	Impianto generatore	Instalación generadora	Stromanlage
Generator, d.c.	Dynamo	Generatore di corrente continua	Generador de corriente contínua	Dynamo (Gleichstrom)
Hammerbreak, magnetic	Interrupteur à marteau	Interruttore magnetico a martello	Interruptor magnético de martillo	Magnetischer Hammerunterbrecher
Ignition	Allumage	Accensione	Ignición *or* Encendido	Zuender (Zuendung)
Ignition apparatus	Appareils d'allumage	Apparecchio di accensione	Aparatos de ignición	Zuendungsvorichtung
Ignition coil	Bobine d'allumage.	Rocchetto di accensione.	Bobina de ignición.	Zuenderspule
Inductance, aerial	Inductance d'antenne	Induttanza sinzatrice dell' antenna	Inductancia de antena	Antenneninduktanz
Inductance, aerial tuning.	Inductance à syntoniser le circuit de l'antenne	Induttanza per la sintonizzazione dell' antenna	Inductancia de sintonización de la antena	Induktanz zum Syntonisieren der Antenne
Inductance, low frequency	Bobine d'inductance du circuit à basse fréquence	Induttanza per il circuito a bassa frequenza	Inductancia del circuito de baja frequencia	Induktanzspule niedriger frequenz
Inductance, primary	Inductance primaire	Induttanza per circuito primario	Inductancia primaria	Primarinduktanz
Inductance coil	Bobine d'Inductance	Induttanza a rocchetto	Bobina de inductancia	Funkeninduktor
Inductance, primary syntonising	Inductance primaire de syntonisation	Induttanza sintonizzatrice del circuito primario	Inductancia primaria de sintonización	Primarinduktanz zum abstimmen
Inductance, syntonising	Inductance de sintonisation	Induttanza sintonizzatrice	Inductancia sintonizadora	Abstimminduktanz
Inductance, variable primary syntonising	Inductance primaire variable de syntonisation	Induttanza, sintonizzatrice del circuito primario, regolabile	Inductancia variable de sintonización del primario	Veranderliche Primarinduktance zum Abstimmen
Induction coil.	Bobine d'Induction	Rocchetto d'induzione	Bobina de inducción	Rhumkorffscher Funkeninduktor
Inkwriter, Morse	Appareil Morse enregistreur	Ricevitore scrivente Morse	Aparto Morse registrador	Schreibempfanger
Insulator, flexible	Isolateur souple	Isolatore, elastico	Aislador flexible	Flexibler Isolator
Insulator, receiving	Isolateur de réception	Isolatore dell' antenna di recezione	Aislador para circuito receptor	Isolator fur den Empfangsdraht
Insulator, transmitting	Isolateur de transmission	Isolatore dell' antenna di transmissione	Aislador para circuito transmisor	Isolator fur die Senderantenne
Interrupter	Rupteur	Interruttore	Interruptor	Unterbrecher
Interrupter, current-	Rupteur de courant	Interruttore di corrente	Interruptor de corriente	Stromunterbrecher

Dictionary of Technical Terms—*Continued*

English.	French.	Italian.	Spanish.	German.
Interrupter, electrolytic	Rupteur électrolytique	Interruttore elettrolitico.	Interruptor electrolítico	Whenelt Unterbrecher
Interrupter, turbine	Turbo-rupteur à mercure	Interruttore a turbina	Interruptor de turbina	Quecksilberturbine-nunterbrecher
Jigger	Transformateur d'oscillations	Transformatore delle correnti oscillatorie	"Jigger"	Jigger, Selbst-induktion des terreger-kreises
Jigger, primary	Primaire de transformateur d'oscillation	Circuito primario del transformatore delle correnti oscillatorie	"Jigger," primario del	Primar-Jigger
Jigger, secondary	Secondaire de transformateur d'oscillation	Circuito secondario del transformatore delle correnti oscillatore	"Jigger," secundario del	Sekundar-Jigger
Jiggers, with heaped windings	Transformateurs d'oscillation à enroulements superposés	Transformatori delle correnti oscillatorie con avvolgimenti a fascio	"Jiggers" con arrollamiento sobrepuestos	Jiggers mit ubereinandergelagerten windungen
Key-sending	Manipulateur	Tasto manipolatore di trasmissione	Manipulador	Taste
Leyden jar	Bouteille de Leyde.	Bottiglia di Leida	Botella de Leyden	Leydener Flasche
Leyden jar, battery of	Batterie de bouteilles de Leyde	Batteria di bottiglie di Leida	Botellas de Leyden, Bateria de	Batterie Leydener Flaschen
Lamp, tuning—and choke	Lampe de sintonisation avec bobine de réactance	Lampada di sintonizzazione con bobina	Lámpara de sintonización y de reactancia	Syntonisierlampe mit Impedanz
Lightning arrester	Parafoudre	Dispositivo scaricafulmine	Pararrayos	Blitzschutz
Mast, portable	Mât, portatif.	Albero, portatile	Mástil, portátil	Tragbarer Mast
Masts, steel sectional	Mâts d'acier à sections	Albero di acciaio di viso in sezioni	Mástil de secciones de acero	Stahlmasten in teilen
Mast, telescopic	Mât, télescopique	Albero telescopico	Mástil telescópico	Teleskopmast
Microphone apparatus	Appareil microphone	Apparecchio microfonico.	Aparato microfónico	Migrophon-Apparat
Micrometer, spark	Micromètre à étincelle	Micrometro di Scintilla	Micrometro de chispa	Funkenmikrometer
Morse Inkwriter. *See* Inkwriter, Morse	—	—	—	—
Motor alternator disc set	Groupe moteur alternateur avec éclateur à disque	Gruppo convertitore con scaricatore a disco	Grupo de motor, alternador con estallador de disco	Wechselstromgenerator kombiniert mit Rotierende Funkenstrecke
Multiple transmission and reception	Transmission et réception multiples	Transmission e Ricezione multipla	Transmisión y recepción múltiple	Vielfach ubermittlung und empfang
Oscillations, electric	Oscillations électriques	Oscillazioni elettriche	Oscilaciones eléctricas	Elektrische-Schwingungen
Plant, radiotelegraphic	Installation radiotélégraphique	Impianto radiotelegrafico	Instalación radiotelegráfica	Radiotelegraphische An[illegible]
Plug, short-circuit	Plot de mise en court circuit	Spina di corto circuito	[illegible] corto [illegible]	[illegible]

Receiver	Appareil récepteur	Apparecchio ricevitore	Receptor	Empfanger
Receiver arrangement	Dispositif de réception	Dispositivo di ricezione	Dispositivo de recepcion	Empfangsvorrichtung
Receiver, flexible	Récepteur souple	Ricevitore flessibile	Receptor flexible	Empfanger
Receiver, vacuum valve	Récepteur à valve d'oscillation	Ricevitore con valvola a vuoto	Receptor de válvula de vacio	Vakuum ventil Empfanger
Rectifiers	Rectificateurs	Raddrizzatori di corrente	Rectificador	Ausgleicher
Relay H.T.	Relais pour haute tension	Soccorritore ad alta tensione	Relevador A.T.	Hochspannungrelais
Relay magnets	Aimants du relais	Magneti di soccorritore	Imanes del relevador	Relais-magnete
Resistance, high	Haute résistance	Alta resistenza	Resistencia, alta	Hoher Widerstand
Resistance, low	Basse résistance	Bassa resistenza	Resistencia, baja	Niedriger Widerstand
Resistance, starting	Rhéostat de démarrage	Reostato di avviamento	Reostato de arranque	Anlasser
Resistance regulating	Rhéostat de champ	—	Resistencia de regulación	Regulierwiderstand
Room, accumulator (battery)	Salle des accumulateurs	Stanza per la batteria di accumulatori	Sala de acumuladores (Batería)	Akkumulatorenraum
Room, engine	Salle des machines.	Locale delle macchine	Sala de máquinas	Maschinenraum
Room engineers	Bureau de l'ingénieur	Ufficio dell' ingegnere	Despacho del Ingeniero	Ingenieur's Bureau
Room, landline	Bureau du service télégraphique	Ufficio telegrafico	Sala del servicio telegrafico	Land Linie Tel. Zimmer
Room, operating	Salle de manipulation et réception	Ufficio radiotelegrafico	Sala telegráfica	Bedienungszimmer fur die Drahtloseinstallation
Room, transmitting.	Chambre des appareils de transmission	Locale di trasmissione	Sala de manipulacion	Senderaum
Saddles, pack	Selles de paquetage	Imbasti	Bastes	Packsattel
Screening box.	Boîte de garde	Cassetta di protezione	Caja de resguardo	Schutzkasten
Sensitive tube.	Tube sensible	Tubo sensibile	Tubo sensitivo	Empfindliche Roehre
Series rheostat	Rhéostat en serie	Reostato in serie	Reostato en serie	Serien Widerstand
Ship station	Station de bord	Stazione navale	Estación de á bordo	Schiffstation
Short circuiting device	Dispositif de mise en court circuit	Dispositivo di messa in corto circuito	Dispositivo de corto circuito	Kurzschliesser
Shelves for condenser spares	Etagère pour matériel de rechange pour condensateur	Scansie per parti di rispetto dei condensatori	Estantes para repuestos del condensador	Bretter fur Reserveteile der Kondensatoren
Shunt, highly inductive	Shunt à pouvoir inductif élevé	Derivazione ad alta induzione	Shunt altamente inductivo	Shunt mit hohe selbstinduktion
Signals, balancing	—	Segnali equilibrati	Señales compensadores	Balanciersignale
Signals, telephone	Signaux téléphoniques	Segnali del telefono	Señales telefónicas	Telephonsignale
Single spark gap	Eclateur simple	Distanza esplosiva semplico	Estallador sencillo de chispa	Einzelfunkenstrecke
Span	Haubanage	Distesa.	Tirante.	Abspannung
Spark	Etincelle	Scintilla	Chispa	Funke
Spark coil, with hammer-break	Bobine d'induction à interrupteur à marteau	Induttore a martello	Bobina de chispa con interruptor de martillo	Funkeninduktor mit Hammer unter brecher
Spark gap	Eclateur à étincelle	Distanza esplosiva	Estallador de chispa	Funkenstrecke

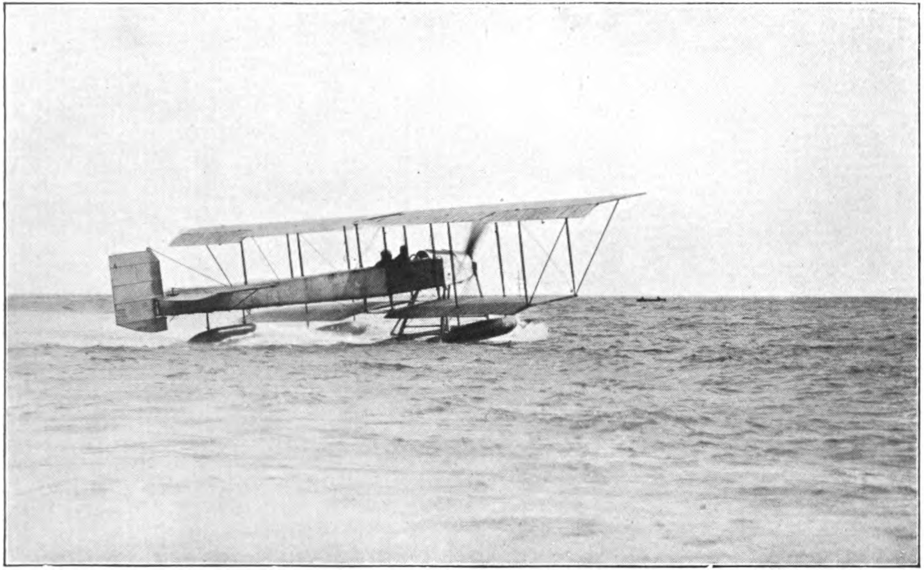
Dictionary of Technical Terms—*Continued*

ENGLISH.	FRENCH.	ITALIAN.	SPANISH.	GERMAN.
Spark gap, micrometric	Eclateur à intervalle micromètique	Distanza esplosiva micrometrica	Estallador micrometrico	Micrometer Funkenstrecke
Spark micrometer	Micromètre à étincelles	Micrometro di scintilla	Micrómetro de chispa	Funkenmikrometer
Spark gap, multiple	Eclateur en série	Distanza esplosiva multipla	Estallador de chispa múltiple	Unterteilte Funkenstrecke
Spark quenched	Etincelle étouffée	Scintilla smorzata	Chispa extinguida	Löschfunke
Starter, automatic	Démarreur, automatique	Avviatore automatico	Reostato de arranque, automático	Selbstanlasser
Starter, combined with shunt regulator	Rhéostat de démarrage avec rhéostat de champ	Reostato di avviamento combinato con regolatore in derivazione	Reostato de arranque y regulador de campo combinados	Anlasswiderstand mit nebenschlussregler
Starter, single-phase	Démarreur monophasé	Avviatore per corrente monofase	Reostato de arranque monofásico	Einphasenanlasser
Starter, three-phase	Démarreur tri-phasé	Acciatore per corrente trifase	Reostato de arranque trifásico	Dreiphasenanlasser
Station, airship	Station de ballon dirigeable	Stazione per aeronave	Estación para globos dirigibles	Luftschiffstation
Station, cart type	Station du type sur voiture	Stazione del tipo su carri	Estación tipo de carros	Karrenstation. Fahrbar station
Station, cavalry	Poste de cavalerie	Stazione per cavalleria	Estación de cavaleria	Kavallariestation
Station, high-power	Station à grande puissance	Stazione di grande potenza	Estación de gran potencia	Kraftstation
Station, knapsack	Poste de Havresac	Stazione da zaino	Estación de mochilas	Tornisterstation
Station, landing	Poste de débarquement	Stazione da sbarco	Estación de desembarco	Landungsstation
Station, long-distance	Poste de grandes distances	Stazione di grande potenza	Estación de gran alcance	Radiotelegraphische Grossstation
Station, portable	Station portative	Stazione portatile	Estación portátil	Tragbare station
Station, portable military	Poste Militaire transportable	Stazione militaire mobile	Estación militar portátil	Tragbare Militarstation
Station, radiotelegraph	Poste radiotélégraphique	Stazione radiotelegrafica	Estación radiotelegráfica	Funkenamt
Station, small-power	Station à faible puissance	Stazione di piccola potenza	Estación de pequeña potencia	Kleinstation
Switch, aerial wire change-over	Commutateur d'antenne	Commutatore dell'antenna	Conmutador para cambio de hilos de antena	Luftdrahtumschalter
Switch, automatic	Interrupteur automatique	Interruttore automatico	Interruptor automático	Selbsttactiger Schalter
Switch, automatic field break	Interrupteur automatique d'excitation	Interruttore automatico ad eccitazione	Interruptor automático del campo	Selbsttaetiger Magnet-ausschalter
Switch, carbon break	Interrupteur à contacts de charbon	Interruttore a carbone	Interruptor con contactos	Kohlenschalter
Switch, change-over	Commutateur	Commutatore	[illegible]	[illegible]

Switch, charging	Interrupteur de charge	Interruttore di carica	Conmutador de carga	Ladeschalter
Switch, combined fuse and	Interrupteur avec coupe circuit	Fusibile ed interruttore combinati	Interruptor con fusible	Schalter und Sicherung-kombiniert
Switch, double-bladed knife	Interrupteur bipolaire à lames	Interrutore doppio a coltello	Interruptor de cuchillo, bipolares	Doppelmesserschalter
Switch, double-pole	Interrupteur bipolaire	Interrutore bipolare	Interruptor bipolar	Zweipoliger Schalter
Switchboard, d.c. and a.c.	Tableau de distribution pour courant continu et alternatif	Quadro di distribuzione per corrente continua ed alternata	Cuadro de distribución de c.a. y c.c.	Schalttafel fuer Gleich und Wechselstrom
Switch, field-break	Interrupteur de l'excitation	Interruttore ad eccitazione	Interruptor del campo	Magnetausschalter
Switch, high-tension	Interrupteur pour haute tension	Interruttore per alta tensione	Interruptor de alta tensión	Hochspannungschalter
Switch, high-tension remote control	Tèlèinterrupteur pour haute tension	Interruttore ad alta tensione comandato a distanza	Teleinterruptor de alta tensión	Hochspannungsfernschalter
Switch, knife	Interrupteur unipolaire a lames	Interruttore a coltello	Interruptor de cuchillo	Messerschalter
Switch, main	Interrupteur principal	Interruttore principale	Interruptor principal	Hauptschalter
Switch, oil-break	Interrupteur à bain d'huile	Interruttore ad olio	Interruptor con baño de aceite	Oelschalter
Switch, press (toggle)	Interrupteur à pression	Interruttore a pressione	Interruptor de tornillo	Druckschalter
Switch, quick-break	Interrupteur à rupture brusque	Interruttore a scatto rapide	Interruptor de rotura brusca	Momentschalter
Switch, single-pole	Interrupteur unipolaire	Interruttore unipolare	Interruptor monopolar	Einpoligerschalter
Switch, three-phase	Interrupteur pour courant tri-phasé	Interruttore tripolare	Interruptor trifásico	Drehstromschalter
Switch, three-way	Commutateur à trois directions	Interruttore a tre vie	Conmutador de tres pasos	3 Wege Umschalter
Switch, voltmeter	Interrupteur du voltamètre	Commutatore per voltometro	Interruptor para voltímetro	Voltmeterumschalter
Syntonisation	Syntonisation	Sintonizzazione	Sintonización	Abstimmung
Syntonised wireless telegraphy	Télégraphie sans fil syntonisée	Radiotelegrafia sintonica	Telegrafía sin hilos sintonizada	Abstimmbare Drahtlose-telegraphie
Table, operating	Table de manipulation	Tavola per il servizio radio-telegrafico	Mesa de aparatos	Radiotelegrafischer Bedienungstisch (Apparattisch)
Tapper	Frappeur	Decoherer	Decohesor de martillo	Klopfer
Telegraphy, directed wireless	Radiotélégraphie dirigée	Radiotelegrafia a sistema dirigibile	Telegrafía sin hilos dirigida	Gerichtete Drahtlose telegraphie
Transformer	Transformateur	Transformatore	Transformador	Transformator
Transformer, high-frequency oscillation	Transformateur d'oscillation à haute fréquence	Transformatore delle correnti oscillatorie ad alta frequenza	Transformador de oscilaciones de alta frecuencia	Umformer fuer Hochfrequenzschwingungen
Transformer, oscillatory	Transformateur d'oscillation	Transformatore delle correnti oscillatorie	Transformador oscilatorio	Oscillationsumformer

Dictionary of Technical Terms—*Continued*

English.	French.	Italian.	Spanish.	German.
Transmitting arrangement	Dispositif d'emission	Dispositivo di transmissione	Dispositivo de transmision	Senderanordnung
Transmitter cavalry	Transmetteur pour cavalerie	Transmettitore di stazione per cavalleria	Transmisor para estación de cavaleria	Kavallariesendeapparat
Transmitter, inductive	Transmetteur à couplage inductif	Transmettitore accoppiato	Transmisor de acoplamiento de induccion	Gekoppelte Sender
Transmitter, sharply-tuned	Transmetteur à syntonisation aigüe	Transmettitore acutamente sintonizzato	Transmisor de sintonización aguda	Scharf abgestimmte Sender
Transmitter, simple (P.A.)	Dispositif d'emission directe	Transmettitore semplice	Transmisor sencillo	Einfacher Sender
Tremblers	Trembleurs	Interruttore a martello	Tembladores	—
Trembler, cantilever	—	—	Temblador de canecillo	—
Trench, covered in for wiring	Canalisation souterraine	Fossa coperta per cavi elettrici	Zanja cubierta para cables	Abgedeckter Kabelgraben
Tube, ebonite	Tube en ébonite	Tubo di ebanite	Tubo de ebonita	Ebonitroehre
Tuning	Syntonisation	Sintonizzazione	Sintonización	Abstimmen
Tuning, flat	Syntonisation non aïgue	Sintonizzazione piana	Sintonización aplastada	Unscharfes abstimmen
Tuner, multiple	Syntonisateur multiple	Sintonizzatore multiplo	Sintonizador múltiple	Vielfach Abstimmapparat
Tuning, note	Hauteur de la note	Sintonizzazione della nota	Sintonización de la nota	Tonhohe der abstimmung
Tuning, note and wave	Note et onde de syntonisation	Sintonizzazione della nota e dell' onda	Sintonización de la nota y de la onda	Abstimmen von Tonhohe und Welle
Tuning wave	Onde de syntonisation	Sintonizzazione della onda	Sintonización de la onda	Welle der Abstimmung
Valve	Valve	Valvola	Válvula	Ventil
Valve, vacuum	Valve à vide	Valvola a vuoto	Válvula de vacio	Vakuum ventil
Voltage	Voltage	Potenziale	Voltaje	Spannung
Voltmeter, a.c.	Voltmètre pour courant alternatif	Voltometro per corrente alternata	Voltímetro c.a.	Voltmeter fur Wechselstrom
Voltmeter, aperiodic	Voltmètre apériodique	Voltometro aperiodico	Voltímetro aperiódico	Aperiodisches Voltmeter
Voltmeter, d.c.	Voltmètre pour courant continu	Voltometro per corrente continua	Voltímetro c.c.	Voltmeter fuer Gleichstrom
Voltmeter, hotwire	Voltmètre à fil chaud	Voltometro a filo caldo	Voltímetro térmico	Hitzdrahtvoltmeter
Voltmeter, switch	Interrupteur de voltmètre	Commutatore per voltometri	Voltímetro, interruptor para	Voltmeterumschalter
Wagon apparatus	Voiture portant les appareils	Carro per gli apparecchi	Aparatos sobre carros	Apparatekarren
Wagon, dynamo	Voiture portant le générateur	Carro per il generatore	Dinamo sobre carros	Kraftkarren-Kraftwagen
Wavelength	Longueur d'onde	Lunghezza d'onda	Longitud de onda	Wellenlaenge



A "Short" Hydroplane of the type supplied to the Admiralty and fitted with Wireless Telegraphy Apparatus.

[To face page 444

USEFUL DATA

WEIGHTS AND MEASURES

Avoirdupois Weight.

drachms.	oz.	lbs.	qrs.	cwts.	ton.	French grammes.
1 =	·0625 =	·0039 =	·000139 =	·000035 =	·00000174 =	1·771846
16 =	1	= ·0625	= ·00223	= ·000558	= ·000028	= 28·34954
256 =	16	= 1	= ·0357	= ·00893	= ·000447	= 453·59
7168 =	448	= 28	= 1	= ·25	= ·0125	= 12,700
28672 =	1792	= 112	= 4	= 1	= ·05	= 50,802
573440 =	35840	= 2240	= 80	= 20	= 1	= 1,016,048

Troy Weight.

grains.	dwts.	oz.	lb.	French grammes.
1 =	·04167 =	00208 =	·0001736 =	·0648
24 =	1 =	·05 =	·004167 =	1·555
480 =	20 =	1 =	·0833 =	31·1035
5760 =	240 =	12 =	1 =	373·242

7000 grains troy = 1 lb. avoirdupois.
175 lbs. troy = 144 lbs. avoirdupois.
lbs. avoirdupois × 1·2153 = lbs. troy.
lbs. troy × ·82286 = lbs. avoirdupois.

Long Measure.

ins.	feet.	yards.	fath.	poles.	furl.	mile.	French metres.
1 =	·083	= ·02778	= ·0139	= ·005	= ·000126	= ·0000158 =	·0254
12 =	1	= ·333	= ·1667	= ·0606	= ·00151	= ·0001894 =	·3048
36 =	3	= 1	= ·5	= ·182	= ·00454	= ·000568 =	·9144
72 =	6	= 2	= 1	= ·364	= ·0091	= ·001136 =	1·8287
198 =	16½	= 5½	= 2¾	= 1	= ·025	= ·003125 =	5·0291
7920 =	660	= 220	= 110	= 40	= 1	= ·125 =	201·16
63360 =	5280	= 1760	= 880	= 320	= 8	= 1 =	1609·315

Measure of Capacity.

pints.	gall.	peck.	bushel.	quarter.	wey.	last.	cub. ft.	litres.
1 =	·125	= ·0625	= ·01562	= ·00195	= ·00039	= ·000195 =	·02 =	·5676
8 =	1	= ·5	= ·125	= ·0156	= ·00312	= ·00156 =	·1604 =	4·543
16 =	2	= 1	= ·25	= ·03125	= ·00625	= ·00312 =	·3208 =	9·082
64 =	8	= 4	= 1	= ·125	= ·025	= ·0125 =	1·283 =	36·32816
512 =	64	= 32	= 8	= 1	= ·2	= ·1	= 10·264 =	290·625
2560 =	320	= 160	= 40	= 5	= 1	= ·5	= 51·319 =	1453·126
5120 =	640	= 320	= 80	= 10	= 2	= 1	= 102·64 =	2906·25

1 gallon in wine, ale, or dry measure
= 277¼ cubic inches = ·16 cubic foot
= 10 lbs. of distilled water =
Cube feet × 6·2355 = gallons.
Cube ins. × ·003607 = gallons.
1 bushel = 2218·19 cube inches = 1·28 cube foot.
Cube feet = ·78 = bushels.
Cube ins. × ·00045 = bushels.

APPROXIMATE VALUES OF BRITISH & FRENCH MEASURES

Linear.

One millimetre (·001 metre) = ·04 inches, or $\frac{4}{100}$ inch, or two-thirds of $\frac{1}{16}$ inch, or $\frac{1}{25}$ inch nearly.

One centimetre (·010 metre) = ·4 inches, or $\frac{4}{10}$ inch nearly.

One decimetre (·100 metre) = 4 inches nearly (exactly $3\frac{15}{16}$ inches).

One metre = 3·28 feet = 3 feet 3 inches and $\frac{3}{8}$ (all but $\frac{1}{512}$ inch) = 40 inches nearly ($\frac{1}{64}$ or 1·6 per cent. less).

To convert metres into inches, multiply by 40.

To convert metres or parts of metres into yards, add $\frac{1}{11}$.

One kilometre (1,000 metres) is about $\frac{5}{8}$ mile (it is 0·6 per cent. less).

One inch is about 25 millimetres (exactly 25·4).

One yard is $\frac{11}{12}$ of a metre. Thus 11 metres are equal to 12 yards.

One inch is about $2\frac{1}{2}$ centimetres (exactly 2·54).

To convert inches into metres, divide by 40.

One mile is about $1\frac{5}{8}$ kilometres (it is 1 per cent. less).

AREA.

One square centimetre is about $\frac{1}{6.5}$ part of a square inch, or ·155 square inch.

One square inch is 6·5 square centimetres.

One square metre contains nearly 11 square feet, or nearly $1\frac{1}{5}$ square yards.

One square yard is nearly $\frac{5}{6}$ of a square metre.

One acre is over 4,000 square metres (it is about 1·2 per cent. more).

One square mile is nearly 260 hectares or metrical acres (10,000 square metres). It is about 0·4 per cent. less.

VOLUME.

One cubic yard is about $\frac{3}{4}$ cubic metre (it is 2 per cent. more).

One cubic metre is nearly $1\frac{1}{3}$ cubic yards (it is $1\frac{2}{3}$ per cent. less).

One cubic metre is nearly $35\frac{1}{3}$ cubic feet (it is ·05 per cent. less).

One litre is over $1\frac{3}{4}$ pints (it is 0·57 per cent. more).

One gallon contains above $4\frac{1}{2}$ litres (it holds about 1 per cent. more).

One kilolitre (a cubic metre) holds nearly 1 ton of water at 62° Fah. ($1\frac{3}{4}$ per cent. less).

One cubic foot contains 28·3 litres.

WEIGHT.

One gramme is nearly $15\frac{1}{2}$ grains (about $\frac{1}{2}$ per cent. less). 1 lb. at London = 445,000 dynes.

One kilogramme is about $2\frac{1}{5}$ lbs. (about $\frac{1}{4}$ per cent. more).

One thousand kilogrammes, or a metric ton, is nearly one English ton (about $1\frac{1}{2}$ per cent. less).

One hundredweight is nearly 51 kilogrammes ($\frac{2}{5}$ per cent. less).

One kilogrammetre is = 7·233 ft. lbs.

One foot pound = ·138 kilogrammetres.

The CHAIN, in LAND MEASURE, is subdivided into 4 *poles* or *perches* (each of $5\frac{1}{2}$ yards) and 100 *links* (each of 7·92 inches).

	Inches.	Feet.	Yards.	Statute Miles.	Metres.
Chain,	792	66	22	$\frac{1}{80}$	20·11662

A FATHOM is six feet.

In approximate work the fathom is taken as $\frac{1}{1000}$, or ·001 nautical mile.

The GEOGRAPHICAL, NAUTICAL, or SEA MILE, or NAUT, depends on the dimensions of the earth, which are known approximately only. The following are estimates of its value:—

	Feet nearly.	Statute Mile nearly.	Metres nearly.
Mean length of one minute of longitude at the equator; being the nautical mile by Admiralty Regulation . . .	6,086	1·1527	1,855
Mean length of one minute of latitude	6,076	1·1508	1,852
One telegraph naut. = 2,029 yds.	6,087	1·1528	1,855·3

The nautical mile is sometimes subdivided into 10 *cables* and 1,000 *fathoms;* the fathom thus obtained being about $\frac{1}{80}$ part longer than the common fathom.

The French *nœud* = British nautical mile.

A LEAGUE is three nautical miles.

A KNOT is a velocity of one nautical mile per hour = 6,086 feet per hour.

MEASURES IN WHICH GEOGRAPHICAL DISTANCES ARE EXPRESSED IN VARIOUS COUNTRIES

		Length in English Yards.		English Miles.		English Miles.		Miles, etc., of different Countries.
Arabia	Mile	2,148	100 =	122·04	and	100	=	81·93
Austria	Mile	10,126	do.	575·34	,,	do.		17·38
Bohemia	Mile	10,137	do.	575·96	,,	do.		17·36
Brabant	League	6,076	do.	345·22	,,	do.		28·96
Burgundy	League	6,183	do.	351·66	,,	do.		28·46
China	Li	632	do.	35·91	,,	do.		278·48
Denmark	Mile	8,244	do.	468·41	,,	do.		21·35
England	Mile	1,760	do.	100·00	,,	do.		100·00
Flanders	League	6,864	do.	390·00	,,	do.		25·64
France	Kilometre	1,093	do.	62·10	,,	do.		161·02
Hamburg	Mile	8,244	do.	468·41	,,	do.		21·35
Hanover	Mile	11,559	do.	656·76	,,	do.		15·22
Hesse	Mile	10,547	do.	599·26	,,	do.		16·68
Holland	Mile	8,101	do.	460·28	,,	do.		21·72
Hungary	Mile	9,113	do.	517·78	,,	do.		19·31
Italy	Mile	2,025	do.	115·05	,,	do.		86·91
Norway	Mile	12,352	do.	701·83	,,	do.		14·25
Portugal	League	6,760	do.	384·09	,,	do.		26·03
Prussia	Mile	8,237	do.	480·68	,,	do.		21·37
Rome	Mile	1,628	do.	92·50	,,	do.		108·11
Russia	Verst	1,167	do.	66·30	,,	do.		150·81
Saxony	Mile	9,905	do.	562·78	,,	do.		17·76
Silesia	Mile	7,083	do.	402·44	,,	do.		24·84
Spain	Common Legua of 8,000 Varas	7,416	do.	421·36	,,	do.		23·73
Spain	Legal Legua of 5,000 Varas	4,635	do.	275·34	,,	do.		37·97
Swabia	Mile	10,126	do.	563·35	,,	do.		17·38
Sweden	Mile	11,700	do.	664·77	,,	do.		15·04
Switzerland	Mile	9,153	do.	520·05	,,	do.		19·23
Turkey	Berri	1,826	do.	103·75	,,	do.		96·38
Tuscany	Mile	1,808	do.	102·72	,,	do.		97·34
Westphalia	Mile	12,151	do.	690·39	,,	do.		14·48

CONTINENTAL WEIGHTS AND MEASURES WITH THEIR ENGLISH VALUES.

The Metric System of Weights and Measures, with trifling variations of denomination, has been adopted in the following countries :—

AUSTRIA	GERMANY	ITALY	SERVIA
BELGIUM	*GREECE	NORWAY	SPAIN
DENMARK	HOLLAND	PORTUGAL	SWEDEN
FRANCE	HUNGARY	§ROUMANIA	SWITZERLAND
		§TURKEY	

Linear Measure	1 Centimètre =	0·3937 inch.
	1 METRE =	39·3701 inch = 3·28 feet = 1·093 yard
	1 Kilomètre =	1093·6 yards = 0·62137 mile.
Weight	1 Milligramme	= 0·015 grains troy.
	1 GRAMME	= 15·43 ,, ,,
	1 Kilogramme	= 2·205 lb. avoirdupois.
	1 Quintal métrique = 100 kilogramme	= 220·5 ,, ,,
	1 Tonneau = 1000 ,,	= 2205 ,,
Measure of Capacity ...	1 LITRE = 1·75 pint.	

* In Greece the following weights may be used :
1 Oke = 2·80 lbs. avoirdupois.
1 Stater = 44 Oke = 123·2 lbs. avoirdupois.

§ In Turkey and Roumania the following weights are also used :
1 Oke = 2·83 lbs. avoirdupois.
1 Kintal = 44 Oke = 125 lbs. avoirdupois.

RUSSIAN WEIGHTS AND MEASURES.—Verst = 0·663 mile. 1 Pood = 40 Pund = 36·12 lbs. avoirdupois. 1 Vedru = 2·7 imperial gallons.

1 Degree = 60 geographical miles = 69 1-6th English statute miles = 9·85 Norway miles = 10·41 Swedish miles = 14·77 Danish miles = 15 German miles = 20 Holland ure = 23·15 Swiss stunden = 104·3 Russian versts = 111·3 French kilomètres.

WEIGHTS AND MEASURES.—A penny weighs ⅓ oz., or 10 grammes; a halfpenny, ⅙ oz. A French centime weighs a gramme; its diameter equals a centimètre, and 100 in a row equal a mètre. 1 centimètre = 10 millimètres = 4-10th of an inch; or 2½ centimètres = 1 inch. An inch is the diameter of a halfpenny. A penny is 1-10th foot in diameter.

FOREIGN AND COLONIAL WEIGHTS AND MEASURES, WITH THEIR EQUIVALENTS IN BRITISH STANDARDS

ARGENTINE REPUBLIC.—Since January 1st, 1887, the use of the French Metric System is compulsory. Other measures sometimes used are—

The Quintal ... ... =	101·40 lbs. avoirdupois
,, Arroba ... ... =	25·35 ,, ,,
,, Fanega ... ... =	1½ Imperial bushels

AUSTRO-HUNGARY.—Metric system. This system also compulsory in Bosnia-Herzegovina from September 1st, 1912.

BELGIUM.—Metric system.

BOLIVIA.—Metric system legal.

The Libra	=	1·014 lb. avoirdupois
,, Quintal	=	101·44 lbs. ,,
,, Arroba { of 25 pounds ...	=	25·36 ,, ,,
,, Arroba { of wine or spirits	=	6·70 Imperial gallons
,, Gallon	=	0·74 ,, gallon
,, Vara	=	0·927 yard
,, Square vara	=	0·859 square yard

BRAZIL.—The Metric system is compulsory, and is used in all official departments. The old weights and measures, which are still partly employed, are—

The Libra	=	1·012 lbs. avoirdupois
,, Arroba	=	32·38 ,, ,,
,, Quintal	=	129·54 ,, ,,
,, Alqueire (of Rio) ...	=	1·1 Imperial bushel
,, Oitava	=	55·34 grains

CANADA.—The legal Weights and Measures are the Imperial yard, Imperial pound avoirdupois, Imperial gallon, and the Imperial bushel. By Act 42 Vict., cap. 16, the British hundredweight of 112 pounds and the ton of 2,240 pounds were abolished, and the hundredweight was declared to be 100 pounds, and the ton 2,000 pounds avoirdupois as in United States, but sometimes contracts stipulate for the British weights.

CHILI.—Metric system legal, and now in general use. Old measures are—

The Ounce = 1·014 oz. avoirdupois.
,, Libra = 1·014 lb. avoirdupois. 25 libras = 1 arroba.
,, Quintal = 101·44 lb. avoirdupois. 20 quintals = 1 tonelada.
,, Vara = 0·927 yard.
,, Square vara = 0·859 square yard.

CHINA.

Weights—	10 Ch'ien ...	=	1 Liang (Tael) = 1·333 oz. avoirdupois or 37·78 grammes
	16 Liang ...	=	1 Kin (Catty) = 1·333 lbs. avoirdupois or 604·53 grammes.
	100 Chin ...	=	1 Tan (Picul) = 133·333 lbs. avoirdupois or 60·453 kilogrammes.

4 ozs. = 3 taels; 1 lb. = ¾ catty or 12 taels; 1 cwt. = 84 catties; 1 ton = 16 piculs 80 catties.

Capacity—	10 Ko	=	1 Sheng (pint) = 1·031 litre
	10 Sheng... ...	=	1 Tou (peck) = 10·31 litre (holding from 6½ to 10 Kin of rice and measuring from 1·13 to 1·63 gallon)

Commodities, even liquids, such as oil, spirits, etc., are commonly bought and sold by weight.

Length—10 Fen	... ... =	1 Ts'un (inch)
10 Ts'un	... ... =	1 Chi'h (foot) = 14·1 English inches by treaty
10 Chi'h	... ... =	1 Chang = 11 ft. 9 in. (141 in. by treaty)
1 Li	... ... =	$\frac{1}{3}$ English mile (about)

The mow, the unit of measurement, is almost exactly one-sixth of an acre.

In the tariff settled by treaty between Great Britain and China, the Chi'h of 14 $\frac{1}{10}$ English inches has been adopted as the legal standard. The standards of weight and length vary all over the Empire, the Chi'h ranging from 9 to 16 English inches, and the Chang (= 10 Chi'h) in proportion; at the treaty ports, the use of foreign treaty standard of Chi'h and Chang is common.

In October, 1907, a decree for uniform weights and measures was issued, making the K'up'ing or Treasury Scale the standard weight. The K'up'ing tael or ounce weighs 575·64 grains. The Haikwan tael weighs 581·47 grains.

COLOMBIA.—Metric system introduced in 1857. In liquid measure the French litre is the legal standard.

The Kilogramme	... ... =	2·204 lbs. avoirdupois			
,, Arroba	... ... =	12½ kilos, or 25 Colombian lbs.			
,, Quintal	... ... =	50	,,	100	,, ,,
,, Carga	... ... =	125	,,	250	,, ,,
,, Libra	... ... =	1·102 lbs. avoirdupois			
,, Vara	... ... =	80 centimetres = about 31 inches.			

DENMARK.—The Metric system has been officially adopted, and under the law of May, 1907, is obligatory in public offices since April 1st, 1910, and generally since April 1st, 1912.

The Pund = 100 Kvint = 1,000 Ort = 1·1023 lb. avoirdupois.

The Centner = 100 Pund = 50 kilos = 110·23 lbs. avoirdupois.

Tœnde, grain = 1·3912 hectolitre = 3·827 bushels.

,, oil = 28·9189 gallons.

,, butter = 224 Pund = 112 kilos = 246·9179 lbs. avoirdupois.

,, coal = 1·7004 hectolitre = 4·6775 bushels.

Pot = 0·9661 litres = 0·2126 gallons.

Viertel = 8 potter = 7·729 litres = 1·7011 gallons.

Ship Last = 2 tons.

Alen (= 2 Fod) = 0·6277 metres = 0·6864 yard.

Kubik fod = 0·031 cubic metre = 1·0918 cubic feet.

Tœndeland = 0·55 hectares = 1·36 acres.

Register ton for sailing ships = 1 ton reg.

,, ,, steamers = 0·89 ton reg.

EGYPT.—The Metric system is generally used.

The Ardeb is used as the unit in all transactions in grain, etc., and is equal to 5·44739 bushels or 43·579 gallons.

The approximate weight of the Ardeb in rotls is—Wheat, 315; Beans, 320; Barley, 250; Maize, 315; Cotton Seed, 270.

Okieh	=	1·3206 ounce
Rotl	=	·99049 lb.
Oke	=	2·7513 lbs.
Cantar, or 100 Rotls or 36 Okes	=	99·0492 lbs.
Diraa Baladi (town)... ...	=	22·8350 inches
Diraa Mimari, for Buildings, &c.	=	29·52812 ,,
Kassabah = 3·88 yards ...	=	139·7663 ,,

Feddan, the unit of measure for land, = 333⅓ sq. kassabahs = 1·03808 acre.

Pic = 6·43 sq. feet ... ... = ·562 sq. Metre

Coal is sold by the British ton and water by ton of one cubic metre.

FRANCE.—

Gramme	=	15·43 grains troy
Kilogramme	=	2·205 lbs. avoirdupois
Quintal Metrique	=	220½ ,, ,,
Tonneau	=	2,205 lbs.
Litre (Liquid)	=	1·76 pint
Hectolitre (Liquid)	=	22 gallons
,, (Dry)	=	2·75 bushels
Mètre	=	39·37 inches
Kilometre	=	1,093 yards
Mètre Cube (Stère)	=	35·314 cubic feet
Hectare	=	2·471 acres
Kilomètre Carré	=	·386 square mile

GERMAN EMPIRE.—The Metric system came into force on January 1st, 1872.

The Gram	=	15·43 grains troy
,, Kilogram	=	2·205 lbs. avoirdupois
,, Tonne, 1,000 Kgs. ...	=	2,205 lbs. = 19·7 cwt.
,, Liter, Mass	=	1·76 Imperial pint
,, Meter, Stab	=	3·28 feet, or 39·37 inches
,, Kilometer	=	1·094 yards (·621 mile), or nearly 5 furlongs
,, Hektar	=	2·47 acres
,, Quadrat, or Sq. Kilometer	=	247 acres.

GREECE.—Metric system introduced 1898.

The Oke	=	2·80 lbs. avoirdupois
,, Cantar	=	123·20 ,, ,,

The Livre	=	1·05 lbs. avoirdupois
,, Baril (wine)	=	16·33 Imperial gallons
,, Kilo	=	0·114 ,, quarter
,, Pike	=	$\frac{3}{4}$ of an English yard
,, Stremma...	=	·242 of an English acre

HOLLAND (THE NETHERLANDS).—The Metric system and, with trifling changes, the Metric Denominations are used.

INDIA.—The Maund of Bengal,

40 Seers	=	$82\frac{2}{7}$ lbs. avoirdupois
The Maund of Madras ...	=	25 ,, ,, (nearly)
,, Tola	=	180 grains troy
,, Guz of Bengal	=	36 inches

An Act to provide for the adoption of an uniform system of weights and measures was passed in 1871. The Act orders: "Art. 2. The primary standard of weight shall be called a seer, and shall be a weight of metal in the possession of the Government of India, equal, when weighed in a vacuum, to the weight known in France as the kilogramme = 2·205 lbs. avoirdupois." "Art. 3. The units of weight and measures of capacity shall be, for weights, the said seer; for measures of capacity, a measure containing one such seer of water at its maximum density, weighed in a vacuum. Unless it be otherwise ordered, the sub-divisions of all such weights and measures of capacity shall be expressed in decimal parts." This Act, however, has never been in operation.

ITALY.—Same as in France, the names only being altered—the kilogramme into the chilogramma, the mètre into the metro, the hectare into the ettaro, etc.

The Grammo	=	15·434 grains troy
,, Chilogramma	=	2.20 lbs. avoirdupois
,, Quintale Metrico ...	=	220 ,, ,,
,, Tonnellata	=	2,200 ,, ,,
,, Litro, Liquid Measure..	=	0·22 Imperial gallon
,, Ettolitro ,, ,, ...	=	22 ,, ,,
,, Ettolitro, Dry Measure	=	2·75 ,, bushels
,, Metro	=	3·28 feet or 39·37 inches
,, Chilometro	=	1,093 yards
,, Metro Cubo	=	35·31 cubic feet
,, Ettaro or Hectare ...	=	2·47 acres
,, Square Chilometro ...	=	0·386 square mile (2·59 sq. chilo. = 1 sq. mile)

JAPAN.—The Mommé ... ... = 2·11 drams or 2·41 dwts. or 120 mommé = 1 lb. avoirdupois

The Kin (Catty) = 160 mommé = 1·322 lb. avoirdupois (0·266 mommé = 1 gramme) or 1·60 lbs. troy
,, Picul (100 kin) ... ... = 132·27 lbs.
,, Kwan = 1,000 mommé... = 8·261 lbs. avoirdupois or 10·04 lbs. troy
,, Shaku ... ... = ·994 foot (3·3 shaku = 1 metre)
,, Kujira Shaku ... ... = 1·242 feet
,, Sün ... ... = 1·193 inches
,, Ken = 6 Shaku ... ... = 5·965 feet
,, Jo = 10 Shaku ... ... = 9·942 feet
,, Chô = 60 Ken ... ... = 357·916 feet, or about $\frac{1}{15}$ mile
,, Ri = 36 Chô ... ... = 2·44 miles
,, Ri (marine) ... ... = 1·15 mile
,, Ri (square) ... ... = 5·9552 square miles
,, Chô = 10 tan ... ... = 2·45 acres
,, Koku, Liquid = 10 To = 100 Sho = 39·7033 gallons
,, Koku, Dry ... ... = 4·9629 bushels
,, Koku (capacity of vessel) = $\frac{1}{10}$ ton
,, To, Liquid ... ... = 3·9703 gallons
,, To, Dry ... ... = 1·9851 peck

MEXICO.—The Metric system is generally used in commercial transactions, but the old Spanish Measures are sometimes used. The principal ones are—

1 Libra ... ... = 1·014 lb. avoirdupois
1 Arroba = 25 Libras ... = 25·357 lbs. ,,
1 Vara = 0·837 metre ... = 2 feet $8\frac{9}{10}$ English inches
1 Legua comun ... ... = 6,666⅔ varas

NORWAY.—The Metric system was introduced in 1879, and became obligatory July 1st, 1882.

The Kilogram = 1,000 gram = 2·204 lbs. avoirdupois
,, Meter = 100 centimeter = 3·28 feet, or 39·37 English inches
,, Hektoliter, Liquid Measure = 100 liter = 22 Imperial gallons
,, Hektoliter, Dry Measure = 100 liter = 2·75 Imperial bushels
,, Kilometer = 1,000 meter = 1,094 yards, or 0·621 of English mile

PERU.—The French Metric system was established by law in 1860. Old measures are—

The Ounce ... ... = 1·014 ounce avoirdupois
,, Libra ... ... = 1·014 lb. ,,
,, Quintal ... ... = 101·44 lbs. ,,
,, Arroba of 25 pounds ... = 25·36 lbs. ,,
,, Arroba of wine or spirits = 6·70 Imperial gallons
,, Gallon ... ... = 0·74 ,,
,, Vara ... ... = 0·927 yard
Square Vara ... ... = 0·859 square yard

PORTUGAL.—The Metric system is the legal standard. The principal old measures still in use are—

The Libra	=	1·012 lb. avoirdupois
,, Almude of Lisbon ...	=	3·7 Imperial gallons
,, Almude of Oporto ...	=	5·6 ,, ,,
,, Alqueire	=	0·36 ,, bushel
,, Moio	=	2·78 ,, quarters

ROUMANIA.—Metric system, but Turkish weights and measures are also used.

RUSSIA.—1 Verst (500 sajènes)...	=	3,500 feet, or two-thirds of a statute mile
1 Sajène (3 arshins)... ...	=	7 feet
1 Arshin (16 vershok) ...	=	28 inches
1 Square Verst	=	0·43941 square mile
1 Dessiatine	=	2·69972 acres
1 Pound (96 zolotniks = 32 lot)	=	$\frac{9}{10}$ of a pound or 14·4 ounces
1 Pood (40 pounds)	=	36·113 lbs. = 0·32244 cwt. or 100 poods = 1·6121 tons. Baltic Freight is usually quoted per ton of 62 poods
1 Vedro (8 shtoffs)	=	2$\frac{3}{4}$ Imperial gallons
1 Chetvert (8 chetveriks) ...	=	5·77 Imperial bushels or 46·2 gals.

SERVIA.—Metric system in use.

SPAIN.—The Metric system was introduced into Spain on January 1st, 1859, and is generally used.

SWEDEN.—Metric system introduced 1879, and became obligatory 1889. British measures are often used in wood and coal trades. The old measures below are sometimes used locally, but to a very small extent.

The Skalpund = 100 ort ...	=	0·937 lb. avoirdupois
,, Fot = 10 tum	=	11·7 English inches
,, Kanna = 140 kubikitum	=	4·6 Imperial pints
,, Mil = 360 ref	=	6·64 English miles

TURKEY.—The Oke, of 400 drams	=	2·8283 lbs. avoirdupois
The Almud	=	1·151 Imperial gallon
,, Kileh	=	0·9120 Imperial bushel
44 Okes = 1 Cantar or Kintal	=	124·3616 lbs. avoirdupois
39·6263 Okes	=	1 cwt.
180 Okes = 1 Tcheké ...	=	509·095 pounds
1 Kileh = 20 Okes	=	0·36 Imperial quarter
816 Kilehs	=	100 Imperial quarters

The Andaze (cloth measure)	=	26·77 inches
,, Arshin (land measure)...	=	6·0548 square feet
,, Dönüm (land measure)	=	1,600 sq. Arshins = 1,076·40 sq. yds.

The Kileh is the chief measure for grain, 100 kilehs are equal to 12·128 Imperial quarters or 35·266 hectolitres.

In 1889 the Metric system of weights was made obligatory for cereals; metric weights were decreed obligatory in January, 1892, but are not enforced.

UNITED STATES.—British weights and measures are usually employed, but the old Winchester gallon and bushel are used instead of the new or Imperial standards. Different States have a legal standard for bushels of certain articles, such as grain and potatoes, varying from 60 lbs. for wheat to 32 for oats.

Wine gallon	=	0·83333 gallon
Ale gallon	=	1·01695 ,,
Bushel	=	0·9692 Imperial bushel

Instead of the British cwt. a cental, of 100 lbs., is used. 1 ton = 2,000 lbs., except coal, which is usually 2,240 lbs. wholesale.

NAUTICAL MEASURES

(From "Lloyds' Calendar," by permission of the Committee of Lloyds.)

12 inches	=	1 foot	6 feet	=	1 fathom
3 feet	=	1 yard	3 nautical miles ...	=	1 league

Sea or Nautical Mile = one-sixtieth of a degree of latitude, and varies from 6,046 ft. on the Equator to 6,092 ft. in lat. 60°.

Nautical Mile for speed trials, generally called the Admiralty Measured Mile ... { 6,080 feet; 1·151 statute miles; 1,853 metres

Cable's length = the tenth of a nautical mile; or approximately, 100 fathoms or 200 yards.

A Knot = a nautical mile an hour, is a measure of speed, but is not infrequently, though erroneously, used as synonymous with a nautical mile.

Length of European Measures of Distances compared with the Nautical Mile of 6,080 feet.

	Length in Nautical Miles.		Length in Nautical Miles.
Nautical Mile	1·000	German Ruthen	4·064
British Statute Land Mile	0·868	Italian Mile	1·000
Austrian Mile	4·094	Norwegian Mile	6·097
Danish Mile	4·064	Russian Verst	0·576
French Kilometre	0·539	Swedish Mile	5·769
German Geographical Mile	4·000		

TABLE FOR CONVERTING NAUTICAL MILES INTO STATUTE LAND MILES

THE ADMIRALTY MEASURED MILE ... ... 6,080 feet.
THE STATUTE LAND MILE ... ... 5,280 feet.

Sea Miles.	Land Miles.	Sea Miles.	Land Miles.	Sea Miles.	Land Miles.
1·00	1·151	8·75	10·075	16·50	18·999
1·25	1·439	9·00	10·363	16·75	19·287
1·50	1·729	9·25	10·651	17·00	19·575
1·75	2·015	9·50	10·939	17·25	19·863
2·00	2·303	9·75	11·227	17·50	20·151
2·25	2·590	10·00	11·515	17·75	20·439
2·50	2·878	10·25	11·803	18·00	20·727
2·75	3·166	10·50	12·090	18·25	21·015
3·00	3·454	10·75	12·378	18·50	21·303
3·25	3·742	11·00	12·666	18·75	21·590
3·50	4·030	11·25	12·954	19·00	21·878
3·75	4·318	11·50	13·242	19·25	22·166
4·00	4·606	11·75	13·530	19·50	22·454
4·25	4·893	12·00	13·818	19·75	22·742
4·50	5·181	12·25	14·106	20·00	23·030
4·75	5·469	12·50	14·393	20·25	23·318
5·00	5·757	12·75	14·681	20·50	23·606
5·25	6·045	13·00	14·969	20·75	23·893
5·50	6·333	13·25	15·257	21·00	24·181
5·75	6·621	13·50	15·545	21·25	24·468
6·00	6·909	13·75	15·833	21·50	24·757
6·25	7·196	14·00	16·121	21·75	25·045
6·50	7·484	14·25	16·409	22·00	25·333
6·75	7·772	14·50	16·696	22·25	25·621
7·00	8·060	14·75	16·984	22·50	25·909
7·25	8·348	15·00	17·272	22·75	26·196
7·50	8·636	15·25	17·560	23·00	26·484
7·75	8·924	15·50	17·848	23·50	27·000
8·00	9·212	15·75	18·136	24·00	27·636
8·25	9·500	16·00	18·424	24·50	28·212
8·50	9·787	16·25	18·712	25·00	28·787

SPEED TABLE

Speed per Hour in Knots.	Nautical Miles per Day.	Nautical Miles per Week.	Speed per Hour in Knots.	Nautical Miles per Day.	Nautical Miles per Week.	Speed per Hour in Knots.	Nautical Miles per Day.	Nautical Miles per Week.
3	72	504	10½	252	1,764	18	432	3,024
3½	84	588	11	264	1,848	18½	444	3,108
4	96	672	11½	276	1,932	19	456	3,192
4½	108	756	12	288	2,016	19½	468	3,276
5	120	840	12½	300	2,100	20	480	3,360
5½	132	924	13	312	2,184	20½	492	3,444
6	144	1,008	13½	324	2,268	21	504	3,528
6½	156	1,092	14	336	2,352	21½	516	3,612
7	168	1,176	14½	348	2,436	22	528	3,696
7½	180	1,260	15	360	2,520	22½	540	3,780
8	192	1,344	15½	372	2,604	23	552	3,864
8½	204	1,428	16	384	2,688	23½	564	3,948
9	216	1,512	16½	396	2,772	24	576	4,032
9½	228	1,596	17	408	2,856	24½	588	4,116
10	240	1,680	17½	420	2,940	25	600	4,200

LENGTH OF A DEGREE IN LATITUDE AND LONGITUDE

Lat.	Degree of Longitude.		Degree of Latitude.		Lat.	Degree of Longitude.		Degree of Latitude.	
°	Stat. Miles.	Naut. Miles.	Stat. Miles.	Naut. Miles.	°	Stat. Miles.	Naut. Miles.	Stat. Miles.	Naut. Miles.
0	69·160	60·000	68·698	59·600	45	48·986	42·498	69·044	59·899
2	·119	59·964	·699	·601	47	47·251	40·993	·068	·920
4	68·992	·855	·702	·603	49	45·459	39·439	·092	·941
6	·783	·673	·706	·607	51	43·611	37·835	·116	·962
8	·491	·419	·712	·612	53	41·710	36·186	·140	·982
10	·116	·093	·719	·618	55	39·758	34·491	·162	60·002
12	67·659	58·697	·728	·625	57	37·756	32·755	·184	·022
14	·120	·229	·738	·634	59	35·707	30·979	·206	·041
16	66·499	57·690	·750	·645	61	33·615	29·164	·228	·059
18	65·797	·081	·764	·657	63	31·481	27·311	·248	·077
20	·015	56·404	·779	·669	65	29·308	25·425	·268	·094
22	64·154	55·657	·795	·683	67	27·100	23·509	·286	·110
24	63·216	54·843	·813	·699	69	24·857	21·564	·302	·124
26	62·201	53·962	·831	·715	71	22·582	19·593	·318	·137
28	61·110	·016	·850	·731	73	20·282	17·597	·333	·149
30	59·944	52·005	·870	·749	75	17·956	15·578	·345	·161
32	58·706	50·931	·892	·767	77	15·607	13·539	·357	·171
34	57·396	49·794	·914	·786	79	13·238	11·484	·367	·179
36	56·016	48·597	·936	·806	81	10·853	9·417	·375	·186
38	54·568	47·340	·959	·826	83	8·456	7·338	·381	·192
40	53·053	46·026	·983	·846	85	6·048	5·248	·387	·196
42	51·473	44·656	69·007	·866	87	3·632	3·151	·390	·199
44	49·830	43·231	·013	·888	89	1·211	1·050	·392	·201

LIGHTHOUSES.

To find the height at which a Light should be put above the sea level to show a given number of miles :—

> Multiply the number of miles by itself, and by 4, and divide the product by 7. Thus a lamp required to show ten miles :—

$$10 \times 10 = 100 \times 4 = 400$$
$$7\overline{)}$$
$$57 \text{ feet.}$$

> The Light should be 57 feet above the sea level.

"THE BEAUFORT SCALE": THE FORCE OF THE WIND.

[Invented by Admiral Beaufort, 1805. Admiral Sir Francis Beaufort, K.C.B., F.R.S., was Hydrographer of the Navy from 1829 to 1855.]

Figures to denote the Force of the Wind.	Description of Wind.	POWER OF THE WIND as regards a well-conditioned Man of War or First-class Clipper Ship.	Rate of the Wind per Hour in Miles.
0	Calm	—	0 to 2
1	Light air	Just sufficient to give steerage way	3–10
2	Light breeze	With which the above ship with all sail set and clean full would go in smooth water: 1–2 knots ..	11–15
3	Gentle breeze	3–4 ,, ..	16–20
4	Moderate breeze ..	5–6 ,, ..	21–25
5	Fresh breeze	In which she could just carry close-hauled: Royals, etc.	26–30
6	Strong breeze	Single Reefs and T.G. sails	31–36
7	Moderate gale	Double Reefs and jib, etc.	37–44
8	Fresh gale	Triple reefs, etc. ..	45–52
9	Strong gale	Close reefs and courses	53–60
10	Whole gale	In which she could just bear close-reefed main topsail and reefed foresail	61–69
11	Storm	Under storm staysails	70–80
12	Hurricane	Bare poles..	above 80

"THE BEAUFORT SCALE": FORMULÆ FOR RECORDING STATE OF THE WEATHER.

B denotes Blue Sky, *i.e.*, clear or hazy atmosphere.
C ,, Cloudy — detached opening clouds.
D ,, Drizzling Rain.
F ,, Fog—FF Thick Fog.
G ,, Gloomy Dark weather.
H ,, Hail.
L ,, Lightning.
M ,, Misty or Hazy—so as to interrupt the view.
O ,, Overcast—*i.e.*, the whole sky covered with an impervious cloud.
P ,, Passing Showers.
Q ,, Squally.
R ,, Rain—continuous rain.
S ,, Snow.
T ,, Thunder.
U denotes Ugly, threatening appearance of the weather.
V ,, Visibility of distant objects.
W ,, Wet dew.
. Dot under any letter, an extraordinary degree.

By the combination of these letters all the ordinary phenomena of the weather may be recorded with certainty and brevity, *e.g.*,

BCM—Blue sky, with detached opening clouds, but hazy round the horizon.

GV—Gloomy dark weather, but distant objects *remarkably* visible.

MEASURES OF TIME.

SIDEREAL DAY.—The standard unit of time is the SIDEREAL DAY, being the period in which the earth turns once round on its axis. It is divided into sidereal hours, minutes, and seconds; but these measures of time are used by astronomers only.

MEAN SOLAR TIME.—A SECOND is the time of one swing of a pendulum adjusted so as to make 86,164·09 swings in a sidereal day. Seconds are usually subdivided decimally.

One MEAN SOLAR DAY = 24 hours = 1,440 minutes = 86,400 seconds = 1·00273791 sidereal day.

RELATION BETWEEN TIME AND LONGITUDE.—At any given instant the mean solar time at two stations differs by an amount

proportional to their difference of longitude, the time at the eastern station being the earlier.

CORRESPONDING DIFFERENCES.

Longitude.	Time.	Longitude.	Time.
15″	1 second.	75°	5 hours.
1′	4 seconds.	90	6 ,,
15′	1 minute.	105	7 ,,
1°	4 minutes.	120	8 ,,
15°	1 hour.	135	9 ,,
30	2 hours.	150	10 ,,
45	3 ,,	165	11 ,,
60	4 ,,	180	12 ,,

To show the exact date of any event, the meridian at which the time is reckoned must be specified. One degree longitude at Equator = 60 nauts = 69·17 statute miles.

STANDARD TIME.

The Hourly Zone System of Standard Time, based on the meridian of Greenwich, has been adopted in many countries, as will be seen from the particulars given below. For Europe the following Standard Times have been adopted :—

WESTERN EUROPE.—Greenwich time.

CENTRAL EUROPE.—Corresponding to the time of the 15th degree of longitude East of Greenwich, or one hour fast of Greenwich time.

EASTERN EUROPE.—Corresponding to the time of the 30th degree of longitude East of Greenwich, or two hours fast of Greenwich time.

The following countries have adopted the meridians mentioned for the purpose of regulating time :—

GREAT BRITAIN, BELGIUM, FRANCE, PORTUGAL, SPAIN, GIBRALTAR, ALGERIA, FAROE ISLANDS.—Meridian of Greenwich or G.M.T.

IRELAND.—Meridian of Dublin, 25m. 21·1s. slow of G.M.T.

HOLLAND.—Meridian of Amsterdam, 19m. 32·1s. fast of G.M.T.

GREECE.—Meridian of Athens, 1h. 34m. 52·9s. fast of G.M.T.

AUSTRIA-HUNGARY, DENMARK, GERMANY, ITALY, MALTA, NORWAY, SERVIA, SWEDEN, SWITZERLAND, TUNIS, CONGO, ANGOLA, GERMAN SOUTH-WEST AFRICA.—Meridian of 15° E., or 1 hour fast of G.M.T.

ICELAND, MADEIRA, LIBERIA and PORTUGUESE GUINEA.—Meridian of 15° West, or 1 hour slow of G.M.T.

AZORES and CAPE VERDE ISLANDS.—Meridian of 30° W., or 2 hours slow of G.M.T.

RUSSIA.—Meridian of Pulkowa, 2h. 1m. 18·6s. East of Greenwich, or practically Eastern European time.

BULGARIA, ROUMANIA, EGYPT, SOUTH AFRICA, CYPRUS, and PORTUGUESE EAST AFRICA.—Meridian of 30° E., or 2 hours fast of G.M.T.

TURKEY.—Although Central European time for West Turkey and Eastern Europe time for Eastern Turkey has been adopted by the Customs and some public offices, the old Turkish mode of reckoning time is still in general use.

ASCENSION.—Meridian of 14° 15′ W., or 57m. slow of G.M.T.

MAURITIUS, REUNION and SEYCHELLES.—60th meridian, or 4 hours fast of G.M.T.

CHAGOS ISLANDS and PORTUGUESE INDIA.—75th meridian, or 5 hours fast of G.M.T.

INDIA (except CALCUTTA) and CEYLON.—Meridian of 82° 30″ E., or 5½ hours fast of G.M.T.

BURMAH.—Meridian of 97° 30″ E., or 6½ hours fast of G.M.T.

STRAITS SETTLEMENTS, FEDERATED MALAY STATES and FRENCH INDO-CHINA.—Meridian of 105° E., or 7 hours fast of G.M.T.

JAVA.—109° 48′ 37·5″ E., or 7h. 19m. 14·5s. fast of G.M.T.

HONG KONG and EAST COAST OF CHINA, SHANGHAI, KIAU CHAU, PHILIPPINE ISLANDS, BRITISH NORTH BORNEO, LABUAN, WESTERN AUSTRALIA.—Meridian of 120° E., or 8 hours fast of G.M.T.

KOREA.—Meridian of 127° 30′ E., or 8½ hours fast of G.M.T.

JAPAN, SEOUL and CHEMULPO.—Meridian of 135° E., or 9 hours fast of G.M.T.

SOUTH AUSTRALIA and GUAM.—Meridian of 142° 30′ E., or 9½ hours fast of G.M.T.

NEW SOUTH WALES, QUEENSLAND, TASMANIA, VICTORIA, NEW GUINEA, CAROLINE ISLANDS.—Meridian of 150° E., or 10 hours fast of G.M.T.

NEW ZEALAND.—Meridian of 172½° E., or 11½ hours fast of G.M.T.

HAWAII or SANDWICH ISLANDS.—Meridian of 157° 30′ W., or 10½ hours slow of G.M.T.

SAMOA.—Meridian of 172½° W., or 11½ hours slow of G.M.T.

ALASKA.—Meridian of 135° W., or 9 hours slow of G.M.T.

CHILI, PANAMA, PERU.—Meridian of 75° West of Greenwich, or 5 hours slow of G.M.T.

COLOMBIA.—Meridian of Bogota, or 4h. 56m. 52·4s. slow of G.M.T.

ECUADOR.—Meridian of Quito, or 5h. 14m. 06·7s. slow of G.M.T.

COSTA RICA.—Meridian of San José, or 5h. 36m. 16·9s. slow of G.M.T.

NICARAGUA.—Meridian of Managua, or 5h. 45m. 10s. slow of G.M.T.

SALVADOR.—Meridian of San Salvador, or 5h. 56m. 32s. slow of G.M.T.

MEXICO.—Meridian of City of Mexico, or 6h. 36m. 26·7s. slow of G.M.T.

HONDURAS.—Meridian of 90° W., or 6 hours slow of G.M.T.

URUGUAY.—Meridian of Monte Video, or 3h. 44m. 48·9s. slow of G.M.T.

ARGENTINE REPUBLIC.—Meridian of Cordova, 4h. 16m. 48·2s. slow of G.M.T.

BRAZIL.—Meridian of Rio Janeiro, or 2h. 52m. 41·4s. slow of G.M.T.

VENEZUELA.—Meridian of Caracas, or 4h. 27m. 43·6s. slow of G.M.T.

NEW BRUNSWICK, NOVA SCOTIA, PRINCE EDWARD ISLAND, MIQUELON, PORTO RICO, MARTINIQUE, GRENADA, TRINIDAD, TOBAGO, BRITISH and FRENCH GUIANA.—Meridian of 60° W., or 4 hours slow of G.M.T.

CUBA.—Local mean time, and not Standard time of the 75th meridian of W. long., is now in use in Cuba. The time ball in approximately 23° 8′ 27″ N., 82° 20′ 55″ W., at Havana, is dropped at local mean noon, corresponding to 5h. 29m. 23·7s. p.m. G.M.T.

CANADA and the UNITED STATES.—The territories are divided into hourly zones, the Standard times for which are respectively 4, 5, 6, 7, and 8 hours slow of Greenwich, the corresponding meridians being 60°, 75°, 90°, 105°, and 120° W. As a rule the time used in Canada, from the East coast to 67½° W., is 4 hours slow of Greenwich (Intercolonial time); between 67½° and 82½° W., 5 hours slow (Eastern time); between 82½° and 97½° W., 6 hours slow (Central time); between 97½° and 112½° W., 7 hours slow (Mountain time); from 112½° W. to the West coast, 8 hours slow of Greenwich (Pacific time).

BRITISH COLUMBIA.—Meridian of 120° W., or 8 hours slow of G.M.T.

CONCISE TABLES OF CONTINENTAL MONIES.

(*Extracted by permission from Bradshaw's Continental Guide.*)

(1) A Concise Table of Foreign Monies, Reduced from English into the Currency of Other Countries at Par.

England.			France, Italy, Belgium, Switzerland.		Germany.		Holland.		United States.		Austria in Notes.	Russia in Notes.
£	s.	d.	Frs.	Cts.	Mks.	Pfg.	Fl.	Cts.	Dols.	Cts.	Kronen.	Roubles.
0	0	0½	0	052	0	04	0	02	0	01	·04	·01
0	0	1	0	104	0	08	0	05	0	02	·08	·03
0	0	2	0	208	0	17	0	10	0	04	·18	·07
0	0	3	0	312	0	25	0	15	0	06	·26	·10
0	0	4	0	416	0	33	0	20	0	08	·38	·14
0	0	5	0	520	0	42	0	25	0	10	·48	·18
0	0	6	0	625	0	50	0	30	0	12	·56	·21
0	0	7	0	729	0	58	0	35	0	14	·66	·25
0	0	8	0	833	0	67	0	40	0	16	·76	·28
0	0	9	0	937	0	75	0	45	0	18	·86	·32
0	0	10	1	040	0	84	0	50	0	20	·96	·36
0	0	11	1	144	0	92	0	55	0	23	1·04	·39
0	1	0	1	25	1	0	0	60	0	25	1·20	·47
0	2	0	2	50	2	0	1	20	0	50	2·40	·95
0	3	0	3	75	3	0	1	80	0	75	3·60	1·42
0	4	0	5	0	4	0	2	40	1	0	4·80	1·90
0	5	0	6	25	5	0	3	0	1	25	6·	2·37
0	6	0	7	50	6	0	3	60	1	50	7·20	2·85
0	7	0	8	75	7	0	4	20	1	75	8·40	3·32
0	8	0	10	0	8	0	4	80	2	0	9·60	3·80
0	9	0	11	25	9	0	5	40	2	25	10·80	4·27
0	10	0	12	50	10	0	6	0	2	50	12·	4·75
0	11	0	13	75	11	0	6	60	2	75	13·20	5·22
0	12	0	15	0	12	0	7	20	3	0	14·40	5·70
0	13	0	16	25	13	0	7	80	3	25	15·60	6·17
0	14	0	17	50	14	0	8	40	3	50	16·80	6·65
0	15	0	18	75	15	0	9	0	3	75	18·	7·12
0	16	0	20	0	16	0	9	60	4	0	19·20	7·60
0	17	0	21	25	17	0	10	20	4	25	20·40	8·07
0	18	0	22	50	18	0	10	80	4	50	21·60	8·55
0	19	0	23	75	19	0	11	40	4	75	22·80	9·02
1	0	0	25	0	20	0	12	0	5	0	24·	9·40
2	0	0	50	0	40	0	24	0	10	0	48·	18·80
3	0	0	75	0	60	0	36	0	15	0	72·	28·20
4	0	0	100	0	80	0	48	0	20	0	96·	37·60
5	0	0	125	0	100	0	60	0	25	0	120·	47·
6	0	0	150	0	120	0	72	0	30	0	144·	56·40
7	0	0	175	0	140	0	84	0	35	0	168·	65·80
8	0	0	200	0	160	0	96	0	40	0	192·	75·20
9	0	0	225	0	180	0	108	0	45	0	216·	84·60
10	0	0	250	0	200	0	120	0	50	0	240·	94·

In France, Belgium, Switzerland and Italy, 1 franc = 100 centimes. Germany, 1 mark = 100 pfennig. Holland, 1 florin or gulden = 100 cents. Norway, Sweden, and Denmark, 1 krone = 100 ore. United States, 1 dollar = 100 cents. Spain, 1 peseta = 100 centimos. Austria, 1 krone = 100 heller. Hungary, 1 korona = 100 fillér. Portugal, 1 milreis = 1000 reis. Greece, 1 drachma = 100 leptas. Turkey, 1 piastre = 40 paras. Russia, 1 rouble = 100 kopecks.

In France, Belgium, Switzerland, Italy and Greece, 5 franc pieces are legal tender in each country, irrespective of the country of origin. Smaller Italian coins only pass in their own country; French, Belgian, Swiss and Greek small silver coins pass indiscriminately, but not the copper or nickel centimes.

Spain.—The silver and paper currency is depreciated, and is subject to considerable fluctuations in value.

(2) Approximate Values of Gold and Silver Coins, Subject to Variations According to the Fluctuations in the Rates of Exchange.

Description of Coin.	Value in English.			United States.		France, Belgium, Switzerland.		German Empire.		Holland.		Austrian Paper.		Italian	
GOLD.	£	s.	d.	Dl.	Ct.	Fr.	Ct.	M.	Pf.	Gl.	Ct.	Kr.	H.	Lr.	Ct.
English Sovereign ...	1	0	0	4	87	25	24	20	48	12	8	24	15	25	50
Twenty Franc Piece	0	15	10	3	84	20	0	16	13	9	54	19	25	20	0
German 20 Mark Piece	0	19	6	4	74	24	70	20	0	11	77	23	50	24	70
Dutch 10 Florins ...		16	4	3	96	20	80	16	60	10	0	19	80	20	80
Imperial (Russian) ...	0	15	10	3	85	20	0	16	13	9	54	18	70	20	0
Twenty Kroner (Swedish, Norwegian, and Danish)	1	1	9	5	25	27	40	22	20	13	10	24	92	27	40
Half-Eagle (5 dolls. U.S.)	1	0	6	5	0	25	85	20	90	12	38	24	50	25	85
SILVER.															
English Shilling ...	0	1	0	0	24	1	25	1	0	0	60	1	14	1	25
Five Franc Piece ...	0	3	11½	0	95	5	0	4	00	2	37½	4	54	5	0
One Franc Piece ...	0	0	9½	0	19	1	0	0	80	0	47½	0	92	1	0
One Mark	0	0	11¾	0	24	1	22	1	0	0	59	1	12	1	22
One Florin (Dutch)...	0	1	7¾	0	40	2	05	1	70	1	0	1	88	2	05
One Krone (Danish, Swedish, and Norwegian)	0	1	1	0	27	1	30	1	13	0	66	1	24	1	30
One Peseta (Spanish)	0	0	7	0	14	0	70	0	60	0	30	0	70	0	70
One Dollar (U.S.) ...	0	4	1	1	0	5	10	4	10	2	46	4	70	5	10

FOREIGN AND COLONIAL MONIES WITH APPROXIMATE VALUE IN BRITISH CURRENCY.

ARGENTINE REPUBLIC.—Gold coin, 5 dollars Silver coins, 1 dollar and 50, 20, and 10 centavos. Bronze coins, 2 and 1 centavos. Nickel coins, 20, 10, and 5 centavos. Silver dollar or peso = 4s. Money in circulation is chiefly paper, being converted at 44 cents gold to dollar = 1s. 9d. Gold dollar = 4s.

AUSTRIA-HUNGARY.—Gold coins, 100 krone = £4 3s. 4d.; 20 krone = 16s. 8d.; 10 krone = 8s. 4d.; Single ducat = 11 crowns 29 heller = 9s. 4¾d. Silver coin, 1 krone = 100 heller = half gulden old coinage = 10d. Exchange about 24 krone to £. Silver gulden or florins (about 12 = £) = 100 kreutzer continue to be legal tender. Nickel, 20 heller = 10 kreutzer of old coinage = 2d., 10 heller = 5 kreutzer of old coinage = 1d. Bronze, 2 heller = 1 kreutzer = ⅕d., 1 heller = ½ kreutzer = $\frac{1}{10}$d.

AUSTRALIA.—The same as in Great Britain.

BELGIUM.—The same as France.

BOLIVIA.—100 centavos = 1 boliviano (paper) = about 1s. 7d., or 12½ bolivianos to £. Coins in circulation are—silver, 50, 30, 20, and 10 centavos; Nickel, 10 and 5 centavos, and English gold coin. Currency principally paper.

BRAZIL.—Currency paper, worth 1s. 4½d. per milreis (1,000 reis) or nearly 15 milrei = £1. Silver coinage of 2, 1, and ½ milreis pieces in circulation.

BRITISH HONDURAS.—100 centavos = 1 dollar (gold) = 4s. 1½d. British sovereign (= $4·86) and half sovereign, and U.S. gold coins legal. Silver coins—5, 10, 25 and 50 cents legal tender to $10. Bronze—1 cent legal tender to 50 cents.

BULGARIA.—Lev (= franc) = 100 stotinki = 9½d. (stotinka = centime). Gold coins, 10 and 20 leva, but foreign 10 and 20 franc pieces principally in circulation. Silver, ½, 1, 2 and 5 leva. Nickel, 2½, 5, 10, 20 stotinki. Bronze, 1, 2, 5, 10 stotinki.

CANADA.—1 cent. = ½d. 100 cents = 1 dollar = about 4s. 1½d. 4 dollars 86⅔ cents = £ sterling. U.S. gold coins also legal.

CHILI.—Gold coins, 20 (colon or condor), 10 (doubloon), and 5 (escudo) peso pieces. Silver coins, 1 peso and $\frac{1}{5}$, $\frac{1}{10}$, and $\frac{1}{20}$ of a pesu. Bronze coins, ½, 1, 2 and 2½ centavo pieces. Currency is paper—the peso or dollar = about 10d. The restoration of the gold currency is projected under a currency law which was to take effect on 1st January, 1910, but has been deferred till 1st January, 1915. Gold peso = 1s. 6d. English sovereign has a legal value of 13⅓ pesos gold.

CHINA.—1,220 (about) cash = 1 haikwan (or customs) tael = about 2s. 8½d. About 35 cash = 1d. A coin recently issued is the "hundredth of a dollar" worth about $\frac{8}{25}$ of 1d. Silver dollar of same value as Japanese silver yen, is also current. At Hong Kong the dollar (1,000 cash) = about 1s. 11d. and at Shanghai about 2s. 8d. In October, 1908, an Imperial Edict decreed the establishment of a uniform Tael currency —unit silver tael to have a value of between 30d. and 40d.

COCHIN CHINA.—5 sapéques or cash = 1 cent.; 100 cents. = 1 dollar = about 2s.

COLOMBIA.—100 centavos = 1 peso or dollar gold—nominal value 4s. Gold coins, 1, 2½ and 5 dollars. Silver coins, real, peseta, half-dollar and dollar. Very few coins are in circulation, the currency being principally paper, subject to considerable fluctuation. At the legal rate the paper peso = 1 centavo gold, or $500 = £1.

DENMARK.—100 ore = 1 krone = 1s. 1¼d. 18 kroner 19 ore = £ sterling. Gold coins of 20 kroners and 10 kroners. Silver, 2 kroner (rigsdaler), 1 krone and 25 ore.

FRANCE.—100 centimes = 1 franc = 9½d. 20 franc piece (Louis or Napoleon = 15s. 10d. About 25 france 25 cents. = £ sterling. Gold coins of 5, 10, 20, 50, and 100 francs. Silver coins, 20 centimes, ½, 1, 2, and 5 franc pieces. Nickel coin, 25 centimes. Bronze coins, 1, 2, 5, and 10 centimes.

GERMAN EMPIRE.—100 pfennig = 1 mark = about 1s. About 20·45 m. = £ sterling. Gold coins, 20 (doppel-krone), 10 (krone), and 5 (half-krone) marks. Silver coins, 1, 2, 3, and 5 marks and 50 pfennige. Thaler = 3 marks = 2s. 11d.

Nickel coins, 20, 10, and 5 pfennige. Bronze coins, 1 and 2 pfennige.

GREECE.—100 lepta = 1 drachma paper = 9d. 27 drachmæ 30 lepta = £1 or about 108 drachmæ per 100 fcs. Foreign gold coins in circulation.

HOLLAND.—100 cents = 1 guilder or florin = 1s. 8d. 12 guilders 10 cent. = £ sterling. Gold coins, 10 florins (16s.). Silver coins, 2½ guilders (rijksdaaler), 1 guilder, ½ guilder and 25 cents.

INDIA.—£1 = 15 rupees. 16 annas = 1 rupee = 1s. 4d. 3 pie = 1 pice, 12 pie = 1 anna = 1d. Lac of rupees = 100,000. Crore of rupees = 10,000,000.

ITALY.—100 centesimi = 1 lira = 9½d. About 25 lire 40 cents. = £ sterling. Gold coins, 100, 50, 20, 10, and 5 lire. Silver coins, 5, 2, 1 lira, and 50 and 20 centesimi. Paper worth much less.

JAPAN.—10 rin = 1 sen = ¼d., 100 sen = 1 yen or dollar = 2s. 0½d. Gold coins, 5, 10, and 20 yen. Silver coins, 10, 20, and 50 sen. Nickel coin, 5 sen. Bronze coins, 1 sen and 5 rin. The unit of account is the gold yen.

MEXICO.—100 centavos = 1 dollar or peso (silver) = 2s. 0½d.

NORWAY.—100 ore = 1 kroner = 1s. 1¼d. Gold coins, 10 and 20 kroners. Exchange 18·19 krone = £ sterling. Paper money principally used; least value, 5 kroner. Below this amount, silver and copper coins.

PORTUGAL.—100 reis = 1 teston = 4d. 1,000 reis = 1 milreis. Paper milreis = about 4s. 1d. Gold coins, 1, 2, 5, and 10 milreis. Currency, principally paper. Conto = 1,000 milreis. In the Azores, 1 milrei = 3s. 6½d.

ROUMANIA.—1 leu = 100 bani = about 9½d. Gold coins, 5, 10, and 20 lei. Silver, 1 leu, 2 and 5 lei. Nickel, 5, 10 and 20 bani.

RUSSIA.—100 copecks = 1 rouble. Silver or paper rouble = 2s. 1½d. Gold coins—15 roubles (imperial), 10 roubles, 7·50 roubles (half-imperial), 5 roubles. 15 paper roubles = 10 roubles gold = roughly 1 guinea. Currency principally paper.

SERVIA.—Dinar = 1 franc = 9½d. Gold coins, 10 and 20 dinars. Silver, ½, 1, 2, 5 dinars. Bronze, 5 and 10 paras. Nickel, 5, 10, 20 paras.

SPAIN.—100 centimos = 1 peseta—about 26·70 pesetas to the £ sterling. Gold coins are 20, 10 and 5 peseta pieces. Silver coins, 1 and 5 pesetas.

STRAITS SETTLEMENT AND MALAY STATES.—Gold dollar = 2s. 4d. Silver coins—50, 20, 10 and 5 cent pieces—are legal tender to 2 dollars, but ½ dollar is unlimited tender. Copper coins —1, ½ and ¼ cents—are legal tender to 1 dollar.

SWEDEN.—Krona of 100 ore = 1s. 1¼d. or 18·19 kr. to the £1. Gold little used. Currency for 5 kr. or more mostly paper.

TURKEY.—40 paras = 1 piastre = 2¼d. nearly. 100 piastres = 1 lira turca or gold medjidie = 18s. 109½ pias = £1. "Purse," sometimes used in accounts = 500 piastres or 5 liras and is calculated = £4 10s. od. Value of piastre varies in different parts of the Turkish Dominions. In Syria, 1 Turkish £ = 130 local piastres and £1 = 143¼ local piastres.

UNITED STATES.—1 cent = about ½d., 100 cents = 1 dollar = 4s. 1½d. 4 dols. 87 cents = £ sterling. Gold coins, 2½ dollar piece, half eagle (5 dollars), 1 eagle (10 dollars), 1 double eagle (20 dollars).

URUGUAY.—100 centavos = 1 dollar (gold) = about 4s. 3d., or \$4·70 = £. Only foreign gold coins (which are legal tender) are in circulation. Silver coins, 10, 20 and 50 cents. and 1 dollar. Nickel, 1, 2 and 5 cents.

VENEZUELA.—Medio = about 2½d.; real = about 5d. Monetary unit is silver bolivar = about 9½d., or 1 franc, or 25·40 bols. to the £. Currency is based on gold standard—no paper in circulation. Coins are gold, silver and nickel, but principal coin is silver dollar of 5 bols. known as "peso fuerte" or simply "fuerte."

THERMOMETRICAL AND BAROMETRICAL TABLE.

THERMOMETERS.

Réaumur.	Centigrade.	Fahrenheit.	
80°	100°	212°	WATER BOILS (when the bar. is at 30 inch = 760 mm.)
76	95	203	
72	90	194	
68	85	185	
64	80	176	
62·7	78·3	173	Alcohol boils (when the bar. is at 30 inch = 760 mm.)
60	75	167	
56	70	158	
52	65	149	
48	60	140	
44	55	131	
43	53	127	Tallow melts.
40	50	122	
36	45	113	
32	40	104	
30·2	37·8	100	Fever heat commences.
29·3	36·7	98	Blood heat.
28	35	95	
24	30	86	
20	25	77	Summer heat.
19	24	76	
16	20	68	
12	15	59	Temperate.
8	10	50	Temperature of spring water.
4	5	41	
0	0	32	WATER FREEZES.
— 4	— 5	23	
— 8	—10	14	
—12	—15	5	
—14·4	—18	0	ZERO (Fahrenheit).

BAROMETER.

Millim.		Inches.
715	=	28·15
720	=	28·35
725	=	28·54
730	=	28·74
735	=	28·94
740	=	29·13
745	=	29·33
750	=	29·53
755	=	29·73
760	=	29·92
765	=	30·12
770	=	30·32
775	=	30·51
780	=	30·71
785	=	30·91
790	=	31·10

Inches.		Millim.
31	=	787·4
30	=	762·0
29	=	736·6
28	=	711·2
27	=	685·8

Intermediate heights, to be added to above.

Millim.		Inches.
1	=	·039
2	=	·079
3	=	·118
4	=	·158
5	=	·197

Inches.		Millim.
0·1	=	2·51
0·2	=	5·1
0·3	=	7·6
0·4	=	10·1
0·5	=	12·7
0·6	=	15·2
0·7	=	17·8
0·8	=	20·3
0·9	=	22·9

BAROMETER.—The weather glass and rainfall in France are measured by the millimètre = 1-1000th of a mètre = ·0394 inches = 4-100th of an inch.

THERMOMETER TABLE.—On the Continent thermometers are frequently graded for both Centigrade and Réaumur.

TEMPERATURE CONVERSION TABLES.

(By permission of the Proprietors of the Electrician.)

For Converting Temperatures Cent. to Fahr.

° C.	° F.	° C.	° F.	° C.	° F.	° C.	° F.
0	+32·0	33	91·4	66	150·8	99	210·2
+1	33·8	34	93·2	67	152·6	100	212·0
2	35·6	35	95·0	68	154·4	105	221·0
3	37·4	36	96·8	69	156·2	110	230·0
4	39·2	37	98·6	70	158·0	115	239·0
5	41·0	38	100·4	71	159·8	120	248·0
6	42·8	39	102·2	72	161·6	125	257·0
7	44·6	40	104·0	73	163·4	130	266·0
8	46·4	41	105·8	74	165·2	135	275·0
9	48·2	42	107·6	75	167·0	140	284·0
10	50·0	43	109·4	76	168·8	145	293·0
11	51·8	44	111·2	77	170·6	150	302·0
12	53·6	45	113·0	78	172·4	155	311·0
13	55·4	46	114·8	79	174·2	160	320·0
14	57·2	47	116·6	80	176·0	165	329·0
15	59·0	48	118·4	81	177·8	170	338·0
16	60·8	49	120·2	82	179·6	175	347·0
17	62·6	50	122·0	83	181·4	180	356·0
18	64·4	51	123·8	84	183·2	185	365·0
19	66·2	52	125·6	85	185·0	190	374·0
20	68·0	53	127·4	86	186·8	195	383·0
21	69·8	54	129·2	87	188·6	200	392·0
22	71·6	55	131·0	88	190·4	210	410·0
23	73·4	56	132·8	89	192·2	220	428·0
24	75·2	57	134·6	90	194·0	230	446·0
25	77·0	58	136·4	91	195·8	240	464·0
26	78·8	59	138·2	92	197·6	250	482·0
27	80·6	60	140·0	93	199·4	260	500·0
28	82·4	61	141·8	94	201·2	270	518·0
29	84·2	62	143·6	95	203·0	280	536·0
30	86·0	63	145·4	96	204·8	290	554·0
31	87·8	64	147·2	97	206·6	300	572·0
32	89·6	65	149·0	98	208·4		

For Converting Temperatures Fahr. to Cent.

° F.	° C.	° F.	° C.	° F.	° C.	° F.	° C.
0	—17·78	31	—0·56	62	16·67	93	33·89
+1	17·23	32	—	63	17·23	94	34·45
2	16·67	33	+0·56	64	17·78	95	35·00
3	16·11	34	1·11	65	18·34	96	35·56
4	15·56	35	1·67	66	18·89	97	36·11
5	15·00	36	2·23	67	19·45	98	36·67
6	14·45	37	2·78	68	20·00	99	37·23
7	13·90	38	3·34	69	20·56	100	37·78
8	13·34	39	3·90	70	21·11	101	38·34
9	12·78	40	4·45	71	21·67	102	38·90
10	12·23	41	5·00	72	22·23	103	39·45
11	11·67	42	5·56	73	22·78	104	40·00
12	11·11	43	6·11	74	23·34	105	40·56
13	10·56	44	6·67	75	23·90	106	41·11
14	10·00	45	7·23	76	24·45	107	41·67
15	9·45	46	7·78	77	25·00	108	42·23
16	8·89	47	8·34	78	25·56	109	42·78
17	8·34	48	8·89	79	26·12	110	43·34
18	7·78	49	9·45	80	26·67	111	43·90
19	7·23	50	10·00	81	27·23	112	44·45
20	6·67	51	10·56	82	27·78	113	45·00
21	6·11	52	11·11	83	28·34	114	45·56
22	5·56	53	11·67	84	28·89	115	46·11
23	5·00	54	12·23	85	29·45	116	46·67
24	4·45	55	12·78	86	30·00	117	47·23
25	3·90	56	13·34	87	30·55	118	47·78
26	3·34	57	13·90	88	31·11	119	48·34
27	2·78	58	14·45	89	31·67	120	48·90
28	2·23	59	15·00	90	32·22	121	49·45
29	1·67	60	15·56	91	32·78	122	50·00
30	1·11	61	16·11	92	33·33	123	50·56

SPHEROIDAL TABLES,

Showing the Length of each Degree of Latitude in Statute Miles, and of Longitude in Minutes of Latitude or Nautical Miles under each Parallel of Latitude.

Latitude.

Length of one Degree in Statute Miles.

Lat.		Lat.		Lat.		Lat.	
0°	68·704	23°	68·810	46°	69·067	69°	69·318
1°	68·704	24°	68·819	47°	69·079	70°	69·326
2°	68·704	25°	68·828	48°	69·092	71°	69·333
3°	68·706	26°	68·838	49°	69·104	72°	69·341
4°	68·707	27°	68·848	50°	69·116	73°	69·348
5°	68·709	28°	68·858	51°	69·128	74°	69·335
6°	68·711	29°	68·868	52°	69·140	75°	69·361
7°	68·714	30°	68·879	53°	69·152	76°	69·367
8°	68·717	31°	68·889	54°	69·164	77°	69·373
9°	68·721	32°	68·900	55°	69·176	78°	69·378
10°	68·725	33°	68·912	56°	69·187	79°	69·383
11°	68·729	34°	68·923	57°	69·198	80°	69·387
12°	68·734	35°	68·934	58°	69·210	81°	69·391
13°	68·739	36°	68·946	59°	69·221	82°	69·395
14°	68·745	37°	68·958	60°	69·231	83°	69·398
15°	68·751	38°	68·970	61°	69·242	84°	69·401
16°	68·757	39°	68·982	62°	69·252	85°	69·403
17°	68·764	40°	68·994	63°	69·263	86°	69·405
18°	68·771	41°	69·006	64°	69·272	87°	69·407
19°	68·778	42°	69·018	65°	69·282	88°	69·408
20°	68·786	43°	69·030	66°	69·291	89°	69·409
21°	68·794	44°	69·042	67°	69·300	90°	69·409
22°	68·801	45°	69·055	68°	69·309		

Longitude.

Length of one Degree in Nautical Miles.

Lat.		Lat.		Lat.		Lat.	
0°	60·410	23°	55·550	46°	41·817	69°	21·521
1°	60·400	24°	55·125	47°	41·050	70°	20·538
2°	60·373	25°	54·684	48°	40·270	71°	19·548
3°	60·326	26°	54·225	49°	39·479	72°	18·553
4°	60·261	27°	53·751	50°	38·676	73°	17·553
5°	60·177	28°	53·259	51°	37·861	74°	16·547
6°	60·074	29°	52·751	52°	37·035	75°	15·536
7°	59·954	30°	52·228	53°	36·198	76°	14·521
8°	59·814	31°	51·688	54°	35·350	77°	13·502
9°	59·656	32°	51·133	55°	34·492	78°	12·478
10°	59·480	33°	50·562	56°	33·623	79°	11·451
11°	59·285	34°	49·976	57°	32·745	80°	10·421
12°	59·072	35°	49·375	58°	31·856	81°	9·388
13°	58·841	36°	48·758	59°	30·958	82°	8·352
14°	58·592	37°	48·127	60°	30·051	83°	7·313
15°	58·325	38°	47·481	61°	29·135	84°	6·272
16°	58·040	39°	46·821	62°	28·211	85°	5·230
17°	57·737	40°	46·146	63°	27·278	86°	4·186
18°	57·416	41°	45·459	64°	26·337	87°	3·140
19°	57·077	42°	44·757	65°	25·388	88°	2·094
20°	56·722	43°	44·042	66°	24·432	89°	1·047
21°	56·348	44°	43·313	67°	23·468	90°	0·0
22°	55·958	45°	42·571	68°	22·498		

CONVERSION TABLES.

(By permission of the Proprietors of the Electrician.)

To reduce	Multiply by
kilometres to miles	·62
kilometres to yards	1100 (1093·6)
metres to yards	1·1
metres to feet	3·3
centimetres to inches	·4
millimetres to inches	·04
millimetres to mils.	40 (39·4)
miles to kilometres	1·6
miles to metres	1609
yards to kilometres	·0009
yards to metres	·9
feet to metres	·3
inches to centimetres	2·54
inches to millimetres	25 (25·4)
mils. to millimetres	·025
sq. metres to sq. yards	1·2
sq. metres to sq. feet	11 (10·76)
sq. centimetres to sq. inches	·155
sq. millimetres to sq. inches	·0015
sq. yards to sq. metres	·83
sq. feet to sq. metres	·09
sq. inches to sq. centimetres	6·45
sq. inches to sq. millimetres	645
cub. metres to cub. yards	1·3
cub. metres to cub. feet	35·3
cub. cms. to cub. inches	·06
cub. yards to cub. metres	·76
cub. feet to cub. metres	·03
cub. inches to cub. cms.	16·4
kilogrammes to tons	·001
kilogrammes to cwt.	·02
kilogrammes to pounds	2·2

To reduce	Multiply by
tons per sq. foot to head of water (metres)	10·7
tons per sq. foot to atmospheres	1·06
lbs. per sq. inch to tons per sq. ft.	·064
lbs. per sq. in. to kilogrammes per sq. cm.	·07
lbs. per sq. inch to grammes per sq. cm.	70·3
lbs. per sq. inch head of water (feet)	2·3
lbs. per sq. inch to head of water (metres)	·7
lbs. per sq. inch to atmospheres	·07
kilogrammes per sq. cm. to tons per sq. foot	·9
kilogrammes per sq. cm. to lbs. per sq. inch	14·2
kilogrammes per sq. mm. to lbs. per sq. inch	1422
grammes per sq. cm. to lbs. per sq. in.	·014
head of water (metres) to tons per sq. foot	·09
head of water (feet) to tons per sq. foot	·027
head of water (metres) to lbs. per sq. inch	1·4
head of water (feet) to lbs. per sq. inch	·43
atmosphere to tons per sq. foot	·94
atmosphere to lbs. per sq. inch	14·7
grains per sq. inch to dynes per sq. cm.	9·8

,,	kilogrammes to ounces	35 (35·3)
,,	grammes to ounces	·035
,,	grammes to grains	15·4
,,	milligrammes to grains	·015
,,	tons to kilogrammes	1000 (1016)
,,	cwt. to kilogrammes	50 (50·8)
,,	pounds to kilogrammes	·45
,,	pounds to grammes	453 (453·6)
,,	ounces to grammes	28·35
,,	grains to grammes	·065
,,	grains to milligrammes	65 (64·8)
,,	lbs. avoir. to grains troy	7000
,,	gallons to cub. feet	·16
,,	gallons to cub. metres	·0045
,,	gallons to litres	4·5
,,	gallons of water to lbs.	10
,,	cub. feet to gallons	6·2
,,	cub. metres to gallons	220
,,	litres to gallons	·22
,,	lbs. of water to gallons	·1
,,	litres to cub. feet	·035
,,	litres of water to lbs.	2·2
,,	cub. feet to litres	28·3
,,	lbs. of water to litres	·454
,,	cub. feet of water to lbs.	62·3 (62·27)
,,	lbs. of water to cub. feet	·016
,,	feet per minute to miles per hour	·0113
,,	feet per minute to metres per sec.	·005
,,	miles per hour to feet per minute	88
,,	metres per sec. to feet per minute	197
,,	tons per sq. foot to kilogrammes per sq. cm.	1·09
,,	tons per sq. foot to lbs. per sq. in.	15·5
,,	tons per sq. foot to head of water (feet)	36
,,	dynes per sq. cm. to grains per sq. inch	0·1
,,	carcels to candles	9·8
,,	candles to carcels	10·2
,,	English candles to German	1·1
,,	German candles to English	·92
,,	*joules to ergs	10
,,	joules to foot lbs.	·737
,,	joules to kilogrammetres	·1
,,	joules to lbs. deg. F.	·0095
,,	joules to calories	·24
,,	calories to joules	4·2 (4·158)
,,	lbs. deg. F. to joules	1048
,,	kilogrammetres to joules	9·8
,,	foot lbs. to joules	1·35
,,	lbs. deg. F. to foot lbs.	772·
,,	lbs. deg. F. to kilogrammetres	107·
,,	lbs. deg. F. to calories	252·
,,	calories to lbs. deg. F.	·004
,,	kilogrammetres to lbs. deg. F.	·009
,,	kilogrammetres to calories	2·34
,,	kilogrammetres to foot lbs.	7·2
,,	foot lbs. to kilogrammetres	·14
,,	calories to kilogrammetres	·42
,,	H. P. to watts	746
,,	H. P. to foot lbs. per minute	33000
,,	H. P. to kilogrammetres per sec.	76
,,	watts to foot lbs. per minute	44
,,	watts to kilogrammetres per sec.	·1
,,	centimes per car-kilometre to pence per car-mile	·16
,,	pence per car-mile to centimes per car-kilometre	·2

* One *joule* = one *watt second.*

SYNOPSIS OF UNITS.

		Dimensions
I.—Fundamental.		
Length—Mass—Time		L—M—T
II.—Derived Mechanical.		
Area	$=L \times L$	L^2
Volume	$=L \times L \times L$	L^3
Velocity	$V=L \div T$	LT^{-1}
Momentum	$=$ mass $\times$ velocity	$L\ M\ T^{-1}$
Acceleration	$A=$ velocity $\div$ time	LT^{-2}
Force	$F=$ mass $\times$ acceleration	$L\ M\ T^{-2}$
Work	$W=$ force $\times$ length	$L^2\ M\ T^{-2}$
Energy (kinetic)	$=\frac{1}{2}$ mass $\times$ velocity^2	$L^2\ M\ T^{-2}$
III.—Derived Electro-Static.		
Quantity	$q=vQ=\sqrt{\text{force} \times \text{distance}^2}$	$L^{\frac{3}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Current	$c=vI=$ quantity $\div$ time	$L^{\frac{3}{2}}\ M^{\frac{1}{2}}\ T^{-2}$
Electro-motive Force / Difference of Potential	$e=\frac{E}{v}=$ work $\div$ quantity	$L^{\frac{1}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Resistance	$r=\frac{R}{v^2}=$ electro-motive force $\div$ current	$L^{-1}\ T$
Capacity	$k=v^2K=$ quantity $\div$ electro-motive force	L
Sp. Ind. Capacity	$=$ quantity $\div$ another quantity	a numeral
IV.—Derived Magnetic.		
Strength of Pole / Quantity of Magnetism	$m=\sqrt{\text{force} \times \text{distance}^2}$	$L^{\frac{3}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Moment of a Magnet	$ml=$ strength of pole $\times$ length of poles	$L^{\frac{5}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Intensity of Magnetisation	$I=$ moment of magnet $\div$ volume	$L^{-\frac{1}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Magnetic Potential	$=$ work $\div$ strength of pole	$L^{\frac{1}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
V.—Derived Electro-Magnetic.		
Current	$C=\frac{c}{v}=$ intensity of field $\times$ length	$L^{\frac{1}{2}}\ M^{\frac{1}{2}}\ T^{-1}$
Quantity	$Q=\frac{q}{v}=$ current $\times$ time $=CT$	$L^{\frac{1}{2}}\ M^{\frac{1}{2}}$
Electro-motive Force / Difference of Potential	$E=ev=$ work $\div$ quantity	$L^{\frac{3}{2}}\ M^{\frac{1}{2}}\ T^{-2}$
Resistance	$R=rv^2=$ electro-motive force $\div$ current	$L\ T^{-1}$
Capacity	$K=\frac{k}{v_2}=$ quantity $\div$ electro-motive force	$L^{-1}\ T^2$
Sp. Ind. Capacity	$=$ displacement $\div$ force	$L^{-2}\ T^2$
Self-induction, or "Quadrant"	$L_s=\frac{ET}{C}=\frac{\text{energy}}{C^2}=\frac{H \times (\text{length})^2}{C}$	L
Ratio of electro-magnetic to electro-static unit of quantity, $v=3 \times 10^{10}$ centimetres per second approximately.		$L\ T^{-1}$

SYNOPSIS OF PRACTICAL UNITS.

Unit.	Symbol.	Name.	Derivation.	Value. C.G.S.	Value. Equivalent.
E. M. F.	E	Volt.	Ampere×ohm.	10^{8}	·926 standard Daniell cell, or ·697 standard Clark cell
Resistance	R	Ohm.	Absolute.	10^{9}	106·3 c.m. mercury, 1 sq. mm. section (14·4521 grm.) at 0°C.
Current	I	Ampere.	Absolute.	10^{1}	
Quantity	Q	Coulomb.	Ampere×second	10^{1}	1·118 milligrammes of silver deposited per second
Capacity	K	Farad.	Coulomb÷volt	10^{-9}	
,,	,,	Microfarad.	1 millionth farad.	10^{-15}	2·5 nauts of D. U. S. cable
Power	Pw	Watt.	Volt×ampere	10^{7}	·0013405 or $\frac{1}{746}$ h.-p.
Work	W	Joule.	Volt×coulomb.	,,	·7373 ft.-lbs.
Heat	WJ 5	Joule.	Amp.^{2}×sec.×ohm.	,,	·238 calorie.
Self-induction	Ls	Quadrant Secohm or Henry	Volt×second ÷ampere.	10^{9}	Electro-magnetic energy stored in the system
Mutual ,,	*Lm*	Quadrant Secohm or Henry	Volt×second ÷ampere.	10^{9}	Electro-magnetic energy stored in the system

PRACTICAL ELECTRIC UNITS.

Resistance, R.—The Ohm is equal to 10^9 C.G.S.* units of resistance. It has been agreed to take as the practical unit of resistance the resistance of a specified column of mercury (B.A. Committee on Electrical Standards, 1892; Report of Electrical Standards Committee of the Board of Trade, October 27th, 1892). This specified column of uniform cross-section is defined by its length, 106·3 cm. at 0° C., and its mass, 14·4521 grammes. If the mass of 1 cc. of water at 4° C. be 1 gramme, the area of the cross-section of such a column will be 1 sq. mm. Thus 1 ohm is the resistance of a column of mercury at 0° C. 14·4521 grammes in mass, and 106·3 cm. in length. For industrial purposes standards in solid metal having the same resistance as this specified column are made and deposited at the Board of Trade and elsewhere. These standards are from time to time compared together, and have their values redetermined in terms of a mercury column.

To obtain the relation between resistances measured in B.A. units, and resistances measured in ohms, we have—

1 B.A. unit = ·9866 ohm.

1 ohm = 1·01358 B.A. Units.

* Electro-magnetic system.

Thus, to reduce B.A. units to ohms, we have to multiply by ·9866 (*i.e.*, deduct 1·34 per cent.). German silver coils having a temperature coefficient of resistance of ·044 per cent. per 1° C., adjusted to be B.A. units at 0° C., become ohms at 30°·5 C. Platinum silver coils, having a temperature coefficient of ·028 per cent. per 1° C., adjusted to be B.A. units at 0°, become ohms at 47°·8 C.

The MEGOHM = one million ohms.

The MICROHM = one millionth ohm.

The *Specific Resistance of Mercury* is thus $\cdot 9407 \times 10^{-4}$ ohms = 94·07 microhms.

The *Legal Ohm* of the Paris Congress, April, 1884, now superseded by the above B.O.T. ohm, is defined as the resistance of a column of mercury 106 cm. long, and 1 sq. mm. section at 0° C.

ELECTRO-MOTIVE FORCE, E.—The VOLT is equal to 10^8 C.G.S.* units of electro-motive force. The E.M.F. of a Clark cell at 15° C. is 1·434 volts. (See *B.O.T. Report.*) Electro-motive force is equivalent to the difference of potential between two points. The VOLT is the electro-motive force which maintains a current of 1 ampere in a conductor whose resistance is the ohm.

CURRENT, I.—The AMPERE is the current, of which the absolute measurement is 10^{-1} C.G.S.* units.

One ampere decomposes ·00009324 gramme of water (H_2O) per second, or deposits 1·118 milligrms. of silver per sec. = 4·025 grms. per hour.

The MILLIAMPERE = $\frac{1}{1000}$ of an ampere.

QUANTITY, Q.—The COULOMB is equal to 10^{-1} C.G.S.* units of quantity. It is the quantity of electricity conveyed by an ampere in a second.

CAPACITY, K.—The FARAD is equal to 10^{-9} C.G.S.* units of capacity. It is the capacity defined by the condition that a coulomb charges it to the potential of a volt.

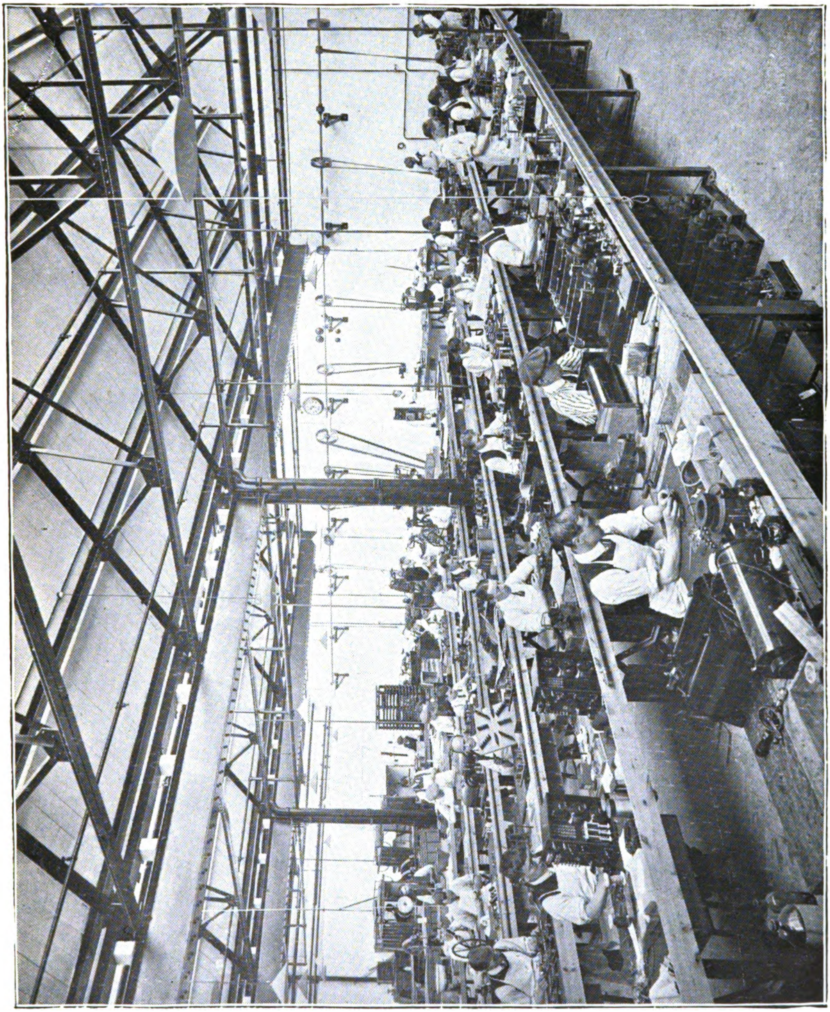
The MICROFARAD, *mfd.* = 10^{-15} C.G.S.* units of capacity, or one-millionth of a Farad.

SELF-INDUCTION, L_s.—The SECOHM,† Quadrant or Henry is equal to 10^9 centimetres or earth's quadrant.

POWER, P_w.—The WATT is equal to 10^7 C.G.S.* units of power. It is the power conveyed by a current of an ampere

* Electro-magnetic system.

† The "secohm" and "quadrant" were the terms used for self-induction until the "Henry" was officially adopted.



View of the Mounting Shop at the Marconi Works, Chelmsford.

[To face page 476

through a conductor whose ends differ in potential by a volt; or, in other words, the rate of doing work when an ampere passes through an ohm, and it is equal to 10^7 ergs per second, or a Joule per second ($\frac{1}{746}$ of a H.P.).

$$\therefore E \times I = I^2 \times R = E^2 \div R = \text{Watts},$$

$$\text{and} \frac{E \times I}{746} = \frac{I^2 \times R}{746} = \frac{E^2}{746\,R} = \text{Horse-power.}$$

The *Board of Trade Commercial Unit* is 1,000 volt-ampere-hours or 1,000 Watt-hours; 10 amperes at 100 volts an hour = one B.T. unit, or equal to 1·34 H.P. working for one hour.

HEAT OR WORK, W_J.—The JOULE is equal to 10^7 C.G.S.* units of work or ergs. It is the work done, or heat generated by a Watt in a second—*i.e.*, the work done or heat generated in a second by an ampere flowing through the resistance of an ohm, or the heat generated by a Coulomb running down through a difference of potential of 1 volt. It is therefore the amount of heat equivalent to 10^7 ergs. Assuming Joule's equivalent = 41,890,000 ergs, it is the heat necessary to raise ·24 gramme of water 1° C.

$$\therefore E\ I\ T = I^2\ R\ T = E^2\ T \div R = E\ Q \text{ Joules.}$$

And since 1 H.P. = 550 ft.-lbs. per second,

$$W^s = \tfrac{550}{746}\ E\ Q = \cdot 7373\ E\ Q \text{ ft.-lb.}$$

HEAT UNITS.

HEAT UNITS.—The French unit of heat is the quantity of heat required to raise 1 gramme mass of water, from 4° (temperature of maximum density) to 5° Cent. = 1 gramme degree Cent. = ·00397 British heat unit. The kilogramme degree Cent. in engineering is called the CALORIE. It is = 3·968 British units of heat (B.Th.U.).

The BRITISH THERMAL UNIT is the amount of heat required to raise 1 pound of water, from 60° Fah. to 61° = 1 pound degree Fah. = 0·2519 calories.

JOULE'S EQUIVALENT,* J, is the amount of ENERGY equivalent to a UNIT OF HEAT. Then, for

1 g.-deg. Cent., $J = 41{\cdot}89 \times 10^6$, say 42×10^6 ergs.

1 Calorie $J = 41{\cdot}89 \times 10^9$, say 42×10^9 ergs.

1 lb.-deg. Cent., $J = 1{\cdot}92 \times 10^{10}$ ergs, or 1,400 ft.-lbs.

1 lb.-deg. Fah., $J = 1{\cdot}07 \times 10^{10}$ ergs, or 778 ft.-lbs.

* See *Science Abstracts*, vol. ii., p. 611, for Rowland's, Griffith's, Schuster's, or the latest values for J.

THE HEAT GENERATED in time, T, by a current, I, through a wire of resistance, R, is

$$\frac{I^2RT}{J} \quad \frac{EIT}{J}$$

where $J = 42 \times 10^6$ and I, R, and E are expressed either in absolute electro-magnetic or electro-static units, and T in seconds.

For practical use, when I is amperes, R ohms, E volts, and T secs., the heat generated in time $T = I^2 R T \times 0{\cdot}24$; or $0{\cdot}24$ E I T calories. Or, ·0009 E I T British units.

LIGHT UNITS.

THE BRITISH STANDARD CANDLE.—The Standard or Parliamentary candle is set up as the official standard under the Metropolis Gas Act of 1860. It is defined as a spermaceti candle to weigh six to the pound and to burn 120 grains per hour. Neither length nor diameter of the candle are specified in the Act. The usual dimensions now are 10 inches long, 0·8 inch diameter at top, 0·9 inch diameter at bottom, weighing 1,200 grains, burning 120 grains per hour, and height of flame 1·75 inches. It is unreliable as a standard of comparison, as individual candles may vary as much as 10 per cent.

THE VERNON HARCOURT OR PENTANE STANDARD is a lamp designed by A. Vernon Harcourt in 1877. It burns air saturated with pentane vapour in an Argand burner. The flame is carefully adjusted in height, and is cut off from the photometer by a screen which permits a clear opening of 47 mm. or 1·8 inches in height. This lamp is now the official standard of the Metropolitan Gas Referees, and is reckoned as 10 standard c.p.

THE CARCEL OR FRENCH UNIT is a Colza oil lamp with clockwork pump. It burns pure Colza oil at the rate of 42 grms. per hour in an Argand burner of specified dimensions, with a special form of glass chimney. It was introduced by J. B. Dumas and Regnault in 1800. Its value, as agreed on at the photometric meeting in Zurich in July, 1907, is 9·82 c.p.

THE GERMAN CANDLE (Normal- or Vereins-kerze) is defined as a paraffin candle 20 mm. diameter, burning with a flame 5 cm. in height. It is unreliable and practically obsolete.

THE HEFNER UNIT (Hefner Einheit or "H. K."—Hefner Kerze) is a lamp produced in 1884 by Hefner von Alteneck, and subsequently adopted as the German official standard. It burns amyl-acetate in an open flame 40 mm. high through an ordinary

wick. It has been certified by the Reichsanstalt, who prescribed its form and dimensions. It has been adopted by the Am.Inst.E.E., and, provisionally, by the U.S.A. Bureau of Standards. Its value is 0·913 c.p. according to Zurich meeting, July, 1907.

RELATION BETWEEN SPARKING DISTANCES AND IMPRESSED VOLTAGE.

In the Standardisation Rules of the American Institute of Electrical Engineers, the following table of sparking distances in air between opposed sharp needle points for various effective sinusoidal voltages is given :—

Kilovolts sq. root of mean sq.	Inches sparking distance.	Kilovolts sq. root of mean sq.	Inches sparking distance.	Kilovolts sq. root of mean sq.	Inches sparking distance.
5	0·225	80	7·1	200	20·25
10	0·47	90	8·35	210	21·30
15	0·725	100	9·6	220	22·35
20	1·0	110	10·75	230	23·40
25	1·3	120	11·85	240	24·45
30	1·625	130	12·90	250	25·50
35	2·0	140	13·95	260	26·50
40	2·45	150	15·0	270	27·50
45	2·95	160	16·5	280	28·50
50	3·55	170	17·10	290	29·50
60	4·65	180	18·15	300	30·50
70	5·85	190	19·20		

Recent tests show that needle-point gaps are not reliable above 100,000 volts. A sphere gap voltmeter is recommended by S. W. Farnsworth and C. L. Fortescue (Proc.Am.Inst.E.E., Feb., 1913). and the tests made by the latter and L. W. Chubb give the following results :—

Diam. of Spheres in C.M.	Gap in C.M.	Volts.
25	2	60,000
25	4	112,000
25	6	165,000
50	8	215,000
50	10	260,000
50	14	350,000

SPECIFIC INDUCTIVE CAPACITIES.

(*By permission of the Proprietors of the Electrician.*)

The *specific inductive capacity* of a substance is the ratio of the capacity of a condenser when its plates are separated by this substance to the capacity of the same condenser when its plates are separated by air at about 760 mm. pressure—no change being made in the condenser except in the substitution of air for the substance in question.

The determination of the specific inductive capacity of a substance does not admit of great accuracy on account of the phenomenon of absorption or soaking in of the charge which causes an apparent diminution * in the specific inductive capacity for charges of short duration as compared with those of long duration. The figures given in the following table should, therefore, only be regarded as approximately correct.

Substance.	Specific Inductive Capacity.	Authority.
Flint glass, very light, density 2·87	6·61	J. Hopkinson
„ light, density 3·2	6·72	J. Hopkinson
„ „	3·01	Wüllner
„ dense, density 3·66	7·38	J. Hopkinson
„ „	3·05	Wüllner
„ extra dense, density 4·5	9·90	J. Hopkinson
„ extra dense	3·16	Wüllner
Crown glass, hard, density 2·485	6·96	J. Hopkinson
„	3·11	Wüllner
Plate glass	8·45	J. Hopkinson
„	5·83 to 6·34	Wüllner
White mirror glass	5·83	Schiller
„ „	6·34	Siemens
Straw-coloured glass	2·96 to 3·66	Schiller
„ „	4·12	Siemens
Paraffin wax	1·977	Gibson & Barclay
„ „	1·96	Wüllner
„ „	2·32	Boltzman
„ „	1·68 to 1·92	Schiller
„ „	2·19 to 2·34	Siemens
Indiarubber, pure	2·12	Schiller
„ „	2·34	Siemens
„ vulcanised	2·69	Schiller
„ „	2·94	Siemens
Resin	2·55	Boltzman
Ebonite	2·21 to 2·76	Schiller
„	3·15	Boltzman
„	2·56	Wüllner
„	2·28	Gordon
Sulphur	2·88 to 3·21	Wüllner
„	3·84	Boltzman
„	2·58	Gordon
Shellac	2·74	Gordon
„	2·95 to 3·73	Wüllner
„	3·15	Boltzman
Gutta-percha	4·2	Faraday
„	2·46	Gordon
Mica	5·0	Faraday
Pitch	1·8	Faraday
Petroleum, spirit, Field's	1·92	J. Hopkinson
„ essence of	2·17	Perot
„ oil, ..Field's	2·07	J. Hopkinson
„ „ common	2·10	J. Hopkinson
„ „	2·04 to 2·07	Silow
„ „ neutral at 21° C.	2·26	E. B. Rosa
Turpentine, commercial	2·23	J. Hopkinson
„ „ at 18·6° C.	2·43	E. B. Rosa
„ oil of, at 17·1° C.	1·94	Quincke
„ „	2·16 to 2·22	Silow
Castor oil	4·78	J. Hopkinson
Sperm oil	3·02	J. Hopkinson
„ at 20° C.	3·09	E. B. Rosa
Benzine	2·20	Silow
„	2·24	Perot
„ at 21° C.	2·45	E. B. Rosa
Bisulphide of carbon at about 11° C.	1·97 to 2·22	Quincke
„ „ „ „	1·81	Gordon
Water at 14° C	83·8	Tereschin
„ 25° C.	75·7	E. B. Rosa
Air at about 0·001 mm. pressure	0·94	Ayrton
„ „ 5 mm. „	0·9985	Ayrton
„ „ „ „	0·9994	Boltzman
Hydrogen at about 760 mm. pressure	0·9997	Boltzman
„ „ „ „	0·9998	Ayrton
Carbon dioxide at about 560 mm. pressure	1·0004	Boltzman
„ „ „ „ „	1·0008	Ayrton
Olefiant gas at about 760 mm. pressure	1·0007	Boltzman
Sulphur dioxide at about 760 mm. pressure	1·0037	Ayrton

* According to M. Perot the reverse is sometimes the case with impure liquids.

SPECIFIC ELECTRICAL RESISTANCE TABLE

METALS, ALLOYS, ELECTROLYTES, INSULATORS.

(By permission of the Proprietors of the Electrician.)

Metals and Alloys.

Metal or Alloy.	Resistance Compared with Copper (approx.)	Specific Resistance in C.G.S. Units at 0° C.	Temperature Coefficient per 1° C.
Aluminium, annealed	2	2,946	0·0039
„ hard-drawn... ...	2	3,160	0·0039
Antimony, pressed	22½	35,900	0·0039
Bismuth, pressed...	83	132,650	0·0054
Cadmium	6¼	6,800	—
Carbon, retort	42,000	67×10^6	—
„ arc light (Carré) ...	4,400	7×10^6	—0·0005
„ glow lamp (Edison-Swan)	2,500	4×10^6	—0·00054
Copper, soft	1	1,580	0·00388
„ hard	1	1,616	0·00388
German silver (Cu 4 parts, Ni 2 parts, Zn 1 part)	13¼	21,170	0·00044
Gold, purest soft	1⅓	1,952	0·00336
„ hard-drawn	1⅓	2,118	0·00365
Iron	6	9,611	0·0048
Lead, pressed	12¼	19,850	0·00387
Lead peroxide, chemically prepared	4×10^6	5590×10^6	—*
Lead peroxide, electrolytically prepared	4×10^6	6780×10^6	—*
Mercury, liquid	59	94,070	0·00072
Manganin (Cu 84 per cent., Mn 12 per cent., Ni 4 per cent.)	26	42,000	0° to 10° C. = +0·000025 10° to 20° C. = +0·000014 20° to 30° C. = +0·000003 30° to 40° C. = 0 40° to 50° C. = —0·000003 50° to 60° C. = —0·000006
Manganese copper (Cu 70 per cent., Mn 30 per cent.)	63	100,600	0·00004
Nickel, pure	7¾	12,290	0·0048
Platinum, pure annealed ...	5	8,222	0·0032
Platinoid (German silver +1 or 2 per cent. of Tungsten)	27¼	43,600	0·00025
Platinum iridium (Pt = 80 per cent., Ir = 20 per cent.)	18⅓	29,375	0·00089
Platinum silver (Pt = 33 per cent., Ag = 66 per cent.)	16¾	26,820	0·00018
Phosphor bronze, commercial ...	5⅓	8,479	0·00064
Silver, annealed	—	1,521	0·00377
„ hard-drawn	—	1,652	—
Tin, pure	6	9,565	0·004
„ pressed	8⅓	13,360	0·0036
Zinc, pressed	3½	5,690	0·0036

* John Shields, *Chem. News*, " No alteration observed on heating up to 115° C."

TABLE SHOWING RELATIVE VALUES OF STANDARD, BIRMINGHAM AND AMERICAN (BROWN & SHARPE) WIRE GAUGES.

Reprinted by permission from the "Engineer's Year Book of Formula, Rules, Tables, Data and Memoranda" for 1913 by H. R. Kempe, M.Inst.C.E. Published by Crosby, Lockwood & Son.

S.W.G.	B.W.G.	A.W.G.	Equivalent in Mils.	Equivalent in Mms.	S.W.G.	B.W.G.	A.W.G.	Equivalent in Mils.	Equivalent in Mms.
7/0			500	12·699	15	15	13	072	1·828
6/0			464	11·785		16		065	1·650
		0000	460	11·683	16		14	064	1·625
	0000		454	11·531		17		058	1·472
5/0			432	10·972			15	057	1·447
	000		425	10·794	17			056	1·421
		000	409	10·388			16	050	1·270
0000			400	10·159		18		049	1·244
	00		380	9·651	18			048	1·218
000			372	9·448			17	045	1·142
		00	365	9·271		19		042	1·066
00			348	8·839	19		18	040	1·016
	0		340	8·635	20		19	036	9140
		0	325	8·254		20		035	8886
0			324	8·229	21	21	20	032	8124
1	1		300	7·620		22		030	7617
		1	289	7·340			21	0284	7213
	2		284	7·213	22			028	7109
2			276	7·010			22	0253	6126
	3		259	6·578		23		025	6347
		2	257	6·527	23			024	6093
3			252	6·400	24	24	23	022	5585
	4		238	6·045	25	25	24	020	5078
4			232	5·892	26	26	25	018	4570
		3	229	5·816	27	27	26	016	4062
	5		220	5·588	28	28	27	014	3555
5			212	5·384	29	29		013	3300
		4	204	5·181			28	0122	3100
	6		203	5·156	30	30		012	3046
6			192	4·876	31		29	011	2800
		5	182	4·622	32			0108	2743
	7		180	4·571	33	31	30	010	2539
7			176	4·470	34	32	31	009	2300
	8		165	4·191	35	33	32	008	2031
		6	162	4·114	36	34	33	007	1777
8			160	4·064	37			0068	1727
	9		148	3·759	38		34	006	1523
9		7	144	3·657			35	0056	1422
	10		134	3·403	39	35	36	005	1269
10		8	128	3·251	40			0048	1219
	11		120	3·047	41		37	0044	1118
11			116	2·946	42	36	38	004	1015
		9	114	2·895	43		39	0036	0914
	12		109	2·768	44		40	0032	0813
12			104	2·641	45			0028	0713
		10	102	2·590	46			0024	0610
	13		095	2·412	47			002	0507
13			092	2·336	48			0016	0406
		11	090	2·286	49			0012	0305
	14		083	2·108	50			001	0253
14		12	080	2·032					

THE GREEK ALPHABET.

Large	Small	Name	Commonly used to designate
Α	α	alpha . .	angles, coefficients.
Β	β	beta . .	angles, coefficients.
Γ	γ	gamma .	specific gravity.
Δ	δ	delta . .	density, variation.
Ε	ε	epsilon. .	base of hyperbolic logarithms.
Ζ	ζ	zeta . .	co-ordinates, coefficients.
Η	η	eta . .	hysteresis (Steinmetz) coefficient, efficiency.
Θ	θ	theta . .	angular phase displacement.
Ι	ι	iota . .	
Κ	κ	kappa . .	dielectric constant.
Λ	λ	lambda .	conductivity.
Μ	μ	mu . .	permeability.
Ν	ν	nu . .	reluctivity.
Ξ	ξ	xi . .	output coefficient.
Ο	ο	omricron .	
Π	π	pi . .	circumference—radius.
Ρ	ρ	rho . .	resistivity.
Σ	σ	sigma . .	(cap.), summation ; (small), slip.
Τ	τ	tau . .	time phase displacement.
Υ	υ	upsilon .	leakage coefficient.
Φ	φ	phi . .	flux.
Χ	χ	chi . .	
Ψ	ψ	psi . .	
Ω	ω	omega . .	(cap.), ohm ; (small), angular velocity.

FOUNDATIONS

(*Reprinted by permission from the "Engineer's Year Book and Formulæ, Rules, Tables, Data, and Memoranda" for 1913 by H. R. Kempe, M.Inst.C.E.* (*published by Crosby, Lockwood and Son*).

In cases where there is any doubt as to the ground being of too soft a nature to bear the weight of the proposed structure a trial pit should be sunk, or borings made with boring-rods; samples of the underlying strata may thus be brought up and examined.

Where a soft stratum overlies firm ground, the foundation should, if possible, be carried down to the firm ground; if this is not possible, piles may be driven to the solid ground and the building supported on them, or a number of piers of brickwork, masonry, or iron cylinders sunk.

Where ground is soft to a great depth a wide trench filled with concrete may distribute the weight over a sufficiently large area to support it, or the trench may be filled with carefully

rammed sand, prevented, by sheeting piling or some other means, from escaping laterally. Another method is to drive a number of piles, which, by the friction of their sides, would bear the weight of the building.

FOUNDATIONS ON DIFFERENT SOILS.

In any structure begun at different levels larger blocks should be used for the deeper parts, if the material admits of it, so as to reduce the number of mortar joints and the risk of unequal settlement.

With Sand or Gravel Foundation overlying Clay on a Slope, intercept water by drain on upper side of building.

Least Depth to escape Effects of Heat and Frost, from 3 ft. to 6 ft., according to the climate. Not less than 3 ft. in England for ordinary soils, and 4 ft. for clay.

Rock.—Good foundation, but must be level; should be levelled, if necessary, in steps. The uneven parts should be filled up with large stones, firmly built with strong cement, or with concrete.

Gravel.—The best foundation.

Sand.—Good foundation, if dry and not liable to be washed away, but this easily occurs; drains with leaky joints may cause a subsidence, or any disturbance of the water-level in the stratum, whether by natural or artificial means, such as pumping operations connected with deep foundations, even at a great distance.

Clay.—Generally very treacherous and damp; the foundation must be deep.

Hard Overlying Soft Ground.—If care is taken that the pressure per unit of area is not greater than the firm layer will bear, it may be wiser to build on it, sinking into it as little as possible.

Soft Ground Overlying Hard Ground.—If the stratum of soft ground does not exceed 15 ft. to 20 ft. it will generally be cheaper to sink down to the firm ground; if not more than about 30 ft. drive piles or sink wells of masonry. If of indefinite depth, the platform must be supported by friction against the sides, and be therefore of considerable thickness.

Made Ground should never be trusted for the support of much weight, even though it may have lain undisturbed for years.

Load which Foundations will Bear.

Safe Load on Ordinary Foundations.

	Tons per sq. ft.		Tons per sq. ft.
1. Rock, moderately hard, strong as the strongest red brick	9·0	7. Loose beds with piling...	1·82
2. Rock of the strength of good concrete	3·0	8. Loose beds with concrete	2·75
3. Rock very soft	1·8	9. Brick, stock, mortar ...	2·5
4. Moist clay and sand ...	1·36	10. Brick, stock, Portland cement, 1 to 1 ...	8·0
5. Coarse sand and dry clay	2·25	11. Concrete, Portland cement, 1 to 6	15
6. Firm stone on dry clay...	3·18	12. Rubble on lias	4

Intensity of pressure on a rock foundation should at no point exceed one-eighth pressure, which would crush the rock.

Buildings seldom press with a weight of more than 1 ton per square foot on foundations.

Safe Load on Materials.

	Cwts. per sq. in.	Tons per sq. ft.		Cwts. per sq. in.	Tons per sq. ft.
Portland cement, concrete, 5 to 1...	2·0	15	Brick in cement ...	·8	5·75
Portland cement, concrete, 10 to 1	1·0	7·5	Granite	10·0	72
Mortar, ordinary ...	·5	3·5	Limestone	9·0	65
Brick in mortar ...	·5	3·5	Sandstone	5·0	38
			Rubble	·5	3·5

Safe Load on Bearing Surface for end of Girders.

	Tons per sq. ft.		Tons per sq. ft.
Granite	15	Brick, stock, in lias ...	5
Portland stone	12	Brick, stock, in lime ...	4
Limestone	9	Earth, compact	2
Brick, blue, in cement ...	9	Earth, made	1
Brick, stock, in cement ...	6		

Safe Load on Chimney Foundations.

	Tons per sq. ft.		Tons per sq. ft.
Granite	45	Concrete, 6 to 1	10
Brick, blue Staff., in cement	20	Clay	4

Safe Load on Stone Walls and Columns.

	Ashlar Walls, single bedstones. Columns, diameter = $\frac{1}{8}$ height. Lbs. per sq. in.	Block in course Columns, diameter = $\frac{1}{12}$ height. Lbs. per sq. in.
Granite	712	570
Hard stone...	356	280
Medium	214	142

Safe Load on Brick Walls and Columns.

	Walls not less than 18 ins. Columns, diameter < $\frac{1}{8}$ height. Lbs. per sq. in.	Walls under 18 ins. Columns, diameter < $\frac{1}{8}$ height. Lbs. per sq. in.	Columns diameter = $\frac{1}{8}$ to $\frac{1}{12}$ height. Lbs. per sq. in.
Brick in mortar	72	36	—
Brick in cement	108	72	—
Brick in Portland cement	142	108	44
Rubble, mortar	58	—	—
Rubble, cement	72	—	—
Pressed bricks in mortar	128	114	108
Pressed bricks in cement	172	142	114
Pressed bricks in Portland cement	100	—	—

Safe Loads on Floors.

	Lbs. per sq. ft.		Lbs. per sq. ft.
Attics	31	Stairs	82
Dwelling-rooms	51	Workrooms	82
Library	72	Hay lofts	102
Dancing	72	Warehouses	112

WIRELESS TELEGRAPH PATENTS

By J. St. Vincent Pletts.

THE records at the Patent Office are always interesting, and when they are those of a new industry they are often instructive as well. The curves below give in graphical form the information relating to wireless telegraphy extracted from these records.

Figure 1 shows the total number of patents accepted and

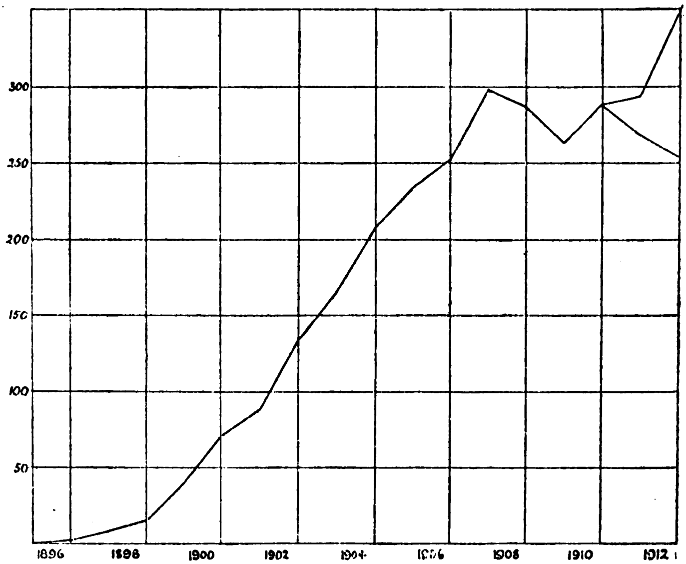


Fig. 1.

still in force from 1896, when wireless telegraphy was born, until the end of last year. It will be seen that three years of infancy was followed by nine years of rapid growth, which has in turn been followed by a well-maintained maturity. The number of new patents each year is now approximately equal to the number which are abandoned or expire, so that there are a constant number of between two hundred and fifty and three hundred always in force. There are, of course, a number of

applications made during the past two years which have not yet been accepted, so that the curve has here two values, between which the final number must lie.

Figure 2 shows the average life of the patents granted each year, and therefore gives a measure of the value of the inventions. The usual tendency with every industry for the life to fall off to about six years is well shown. The rises in 1897

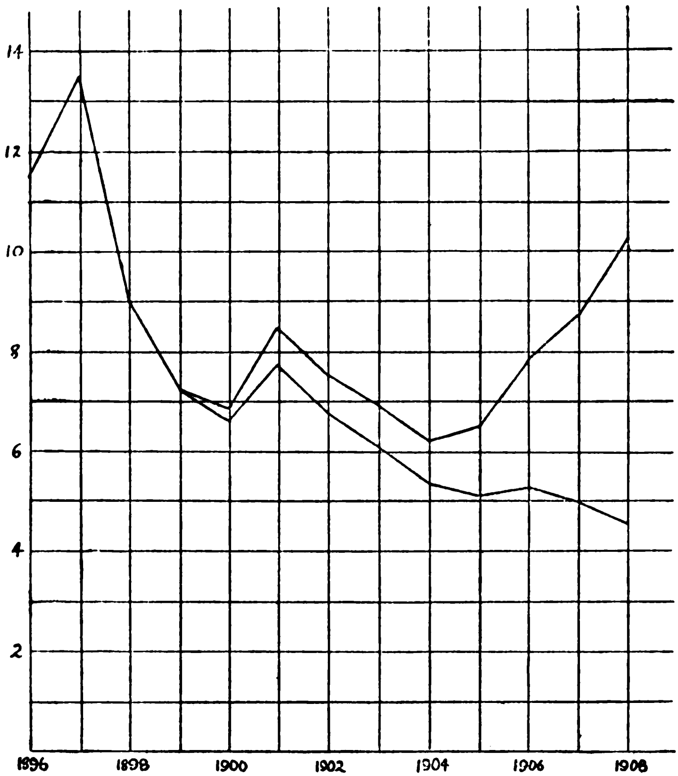


Fig. 2.

and 1901 are, however, remarkable. Only a small part of the former is due to the prolongation of Lodge's Patent No. 11575 of 1897, and the rest is doubtless due to the new fields opened out to the inventor by Marconi's Patents Nos. 12039 of 1896 and 7777 of 1900. A number of the patents taken out since 1899 are still in force, so that the curve here has two values, between which the average life must lie. These limits get so

wide after 1908 that no inferences can be drawn, and the curve is therefore not continued beyond this date.

The patent situation in regard to wireless telegraphy has been brought towards a successful solution by the results of litigation in Europe and America.

The important action brought by Mr. Marconi and Marconi's Wireless Telegraph Company, Ltd., to restrain the British Radio-telegraph and Telephone Company, Ltd., from infringing the plaintiffs' patent, No. 7,777 of 1900, was the first of the actions that cleared the way for similar actions elsewhere. This case was heard before Mr. Justice Parker (now Lord Justice Parker) in the Chancery Division of the High Court of Justice in London, in December, 1910, and January, 1911.

Mr. Marconi and his company claimed that the defendants had manufactured and sold, and were offering for sale, apparatus infringing their Patent No. 7,777 of 1900, and asked for an injunction, damages, delivery up of infringing apparatus, and costs.

The defendants contended that they had not infringed the patent and that the patent was not valid, and in support of their contention cited numerous documents and called no fewer than seven witnesses.

In support of their contention of non-infringement the defendants argued that a two-coil transformer was an essential feature of the invention, that they were using a one-coil or auto-transformer, and that an auto-transformer was not a known equivalent of a transformer at the date of the patent. Further, they argued that if the auto-transformer they were using was an infringement they might use instead a single coil with an equal number of turns in each circuit which would not even be an auto-transformer, and, therefore, could not infringe.

In the course of his now famous judgment, which was a masterpiece of clear reasoning and lucid statement, Mr. Justice Parker reviewed the progress of wireless telegraphy generally, and the problems which its practical application had involved. He pointed out that wireless telegraphy, in the sense used before him, operated by disturbances in the ether produced by the sudden discharge of a condenser, and in this respect was entirely different to magnetic induction telegraphy. Moreover, the effect produced on the receiver fell off in the latter case as the cube of

the distance from the transmitter, and in the former case only as the square of the distance, from which it followed that the utilisation of these disturbances for conveying signals must be far more efficient than the utilisation of lines of magnetic force.

Henry first noticed that the discharge from a condenser was oscillatory. Kelvin and Helmholtz established the relation between the frequency of the discharge and the resistance, capacity and inductance of the circuit. Clerk Maxwell showed that the oscillatory discharge of a condenser must give rise to a disturbance in the ether travelling with the velocity of light. Hertz supplied the experimental verification of Clerk Maxwell's theory and produced the well-known Hertz radiator and resonator, the latter having a minute spark-gap. Branly and Lodge produced the coherer, which, substituted for the minute spark-gap of Hertz's resonator, made a much more sensitive receiver. In 1892 Crookes first suggested the utilisation of Hertz's waves for wireless telegraphy, and in 1894, the year after Hertz's death, Lodge gave his famous lecture on "The Work of Hertz." In this lecture Lodge gave a very clear and complete account of the knowledge of Hertzian waves at that date; he pointed out the necessity for a persistent train of waves in order to obtain selectivity, and stated that conspicuous energy of radiation and persistent oscillation were incompatible—a statement which is true to-day, when we remember that he was referring to a single circuit.

In 1896 Marconi applied for his Patent No. 12,039 of 1896, which was the first patent ever granted for a system of ether wave telegraphy. It embodied, among a large number of minor improvements, the utilisation of an elevated aerial and an earth, but had a number of drawbacks. Not only was there the drawback, pointed out by Lodge, that being a good radiator the aerial could not be a good oscillator, but it also suffered from the limitation of capacity and potential of the aerial and therefore of the energy which could be utilised.

In 1897 Lodge applied for his Patent No. 11,575 of 1897, in which he employed an inductance with a large capacity aerial in order to prolong the train of waves and improve selectivity. He thus made a compromise, sacrificing the radiating in order to improve the oscillating properties of his aerial. In other respects his system resembled Marconi's. His aerial was vertical and not horizontal, and he said it might be earthed if desired; he, too,

used a coherer of metal fittings with a mechanical decohering arrangement.

Later in the same year Lodge applied for another patent, No. 29,505 of 1897, and in the following year Sylvanus Thompson applied for Patent No. 525 of 1898. Both these patents relate to inductive telegraphy, and neither of them throws any light on the difficulties incident to utilising the principle of resonance in a system of telegraphy by ether waves.

Marconi also applied for Patents Nos. 12,326 of 1898, 6,892 of 1899, and 12,186 of 1899, all of which refer to the use of a transformer in the receiver for the purpose of increasing the voltage applied to the coherer.

It is true that Braun's Patent No. 1,862 of 1899 preceded Marconi's Patent No. 7,777 of 1900, but there is no evidence that it was put into practice.

Marconi commenced his specification with the statement that the object of his invention was to increase the efficiency and to secure selectivity. He obviously referred to the difficulty pointed out by Lodge, namely, that the circuit could not do two incompatible things, however desirable, at the same time, and he said in effect: "Take two circuits and let one do one of the things and the other do the other!" For this purpose he employed a closed oscillating circuit coupled to an open radiating or absorbing circuit, and adjusted all four circuits to have the same time period.

The interpretation which he (Mr. Justice Parker) put on the patent seemed to him after careful consideration the true, and indeed the only possible, interpretation, but before leaving the subject he mentioned the matter of coupling, upon which considerable stress was laid at the trial. It was contended that loose coupling was essential to success, that no direction as to coupling was given, and that in one out of the nine examples given the coupling was not very loose. In the opinion of the Judge the direction to couple loosely was impliedly, if not expressly, given in the specification.

It was not disputed that the invention did get over the difficulties it was designed to meet. It produced a persistent train of waves, increased the available energy, doubled at once the distance of communication, and secured selectivity. The utility of the invention could not be doubted.

Mr. Justice Parker next considered whether the invention was anticipated by Braun's Patent No. 1,862 of 1899. The latter,

he said, involved many difficulties, and Braun was evidently unacquainted with what Marconi and Lodge had already done. The essential feature of Braun's invention was the utilisation of lower frequencies than he thought were being used, and it was clear that the specification did not contain even the remotest suggestion of the problem which Marconi's patent of 1900 was intended to solve, much less any suggestion bearing on its solution.

The Judge added that the accuracy of this conclusion would be further evident by considering the objection founded on want of subject matter. In considering this plea it was important to remember that two circuits in the receiver were no novelty. Lodge had two circuits in his 1897 patent. He had two circuits at his receiving end, and, in a way, at his transmitting end also, and yet he failed to see that if he utilised the principle of resonance as between those two circuits the problem would be solved. Marconi had two circuits in his 1898 patent and did not tune them. In the transformers of Tesla and Oudin rough tuning was done to overcome the disadvantage of comparatively loose coupling, but this was only with the object of raising the voltage, and was a very different thing from deliberately loose coupling and tuning two circuits together with the object of producing a long train of waves and securing the full benefit of resonance between the receiver and transmitter. In the literature quoted there was no trace of the idea underlying Marconi's invention, and not a single suggestion from which a competent engineer could arrive at this idea. Mr. Justice Parker held, therefore, that the plea of want of subject matter entirely failed.

The only other plea of invalidity was based on the prior grant of Braun's Patent No. 22,020 of 1899. This patent was similar to the previous one, with the addition of an earthed aerial. Braun said nothing of tuning, and the specification contained a passage which in the opinion of the Judge was inconsistent with the two circuits being intended to be tuned together. It was impossible to see how it could be said that this patent contained a grant of the invention described in Marconi's 1900 patent.

Having come to the conclusion that Marconi's 1900 patent was a good and valid patent, Mr. Justice Parker next considered the question of infringement. The defendants' transmitter contained two circuits, one a closed circuit which was a good conserver of energy and a persistent oscillator, and the other an open circuit which was a good radiator. These circuits were intended

to be tuned together and contained adjustable devices for that purpose. They were also linked together in such a way that the oscillations in the closed circuit would gradually build up and maintain in the open circuit like oscillations, thus radiating a long train of waves. Similarly, the receiver contained two tunable circuits linked together. It appeared, therefore, that the defendants' apparatus contained all the essential features protected by Marconi's 1900 patent.

It was contended that an auto-transformer such as the defendants were using was not a known equivalent of a transformer at the date of the patent, and further that they might use an inductive shunt which would not be a transformer at all. Mr. Justice Parker said he could not conceive, however, that an electrical engineer in, say, 1899, would have had any doubt that what could be done by a two-coil air core transformer could also be done by an air core auto-transformer, and this even if arranged one to one, although an inductive shunt had never been used as a transformer before. In his opinion, however, the use of a two-coil instrument was not an essential feature of Marconi's invention at all, and it was a matter of indifference whether a transformer or an auto-transformer were used.

Being of opinion that every claiming clause of Marconi's patent of 1900 was a claim for an entirely novel combination producing an entirely new and useful result, and that the use of a two-coil transformer was no essential part of his invention, he held that the defendants, who in his opinion had taken all the essential parts of his invention, were infringers, notwithstanding that the substitution of an auto-transformer with an air core for any such purpose as that for which Marconi had used the transformer might have been new. He therefore gave judgment for the plaintiffs and the injunction asked for.

Since this action the defendants in a number of other actions which were commenced both in England and abroad have agreed to judgments against themselves. In France, however, the actions for infringement of the corresponding French patent against the Société Générale des Transports Maritimes, Compagnie Radiotélégraphique, Société Radioélectrique, and others, came to trial, and a judgment similar to and no less decisive than the above was delivered at the end of 1912.

PATENTS APPLICATIONS IN 1911-12

GREAT BRITAIN.

1911.

Number.	Date.	Patentee and Description.
2242	Jan. 28.	HEINRICH LANGE—Aerial conducting structures for Wireless Telegraphy and Telephony.
2456	Jan. 31.	H. SHOEMAKER and C. WILSON—Wireless Telegraphy.
2617	Feb. 1.	R. A. FESSENDEN—Wireless signalling.
2632	Feb. 1.	E. BELLINI and A. TOSI—Antennae for Wireless Telegraphy and Telephony.
3334	Feb. 9.	M. F. SUETER, F. M. BOOTHBY, and H. G. PATERSON—Combined magneto-ignition gear for internal combustion engines and Wireless Telegraphic apparatus particularly applicable to airships.
3644	Feb 13.	J. G. BALSILLIE—Control of high-frequency oscillations for use in Wireless Telegraphy.
3946	Feb. 16.	EMILE GIRARDEAU—Automatic commutator for radiotelegraphic plants with indirect excitation.
3947	Feb. 16.	EMILE GIRARDEAU—Radiotelegraphic plant.
3949	Feb. 16.	EMILE GIRARDEAU—Sender with direct excitation or radiotelegraphic plant.
4332	Feb. 21.	E. FOURNIER D'ALBE—Silenium cells.
4488	Feb. 22.	F. J. CHAMBERS—Transmitter for signalling by electro-magnetic waves.
5187	March 1.	J. G. BALSILLIE and THE BRITISH RADIO TELEG. AND TELEPH. CO.—Spark dischargers for Wireless Telegraphy.
5248	March 2.	ERICH F. HUTH, G.m.b.H., and RICHARD HIRSCH—Wireless Telegraphic apparatus.
5997 6449	March 10 and 14.	W. T. DITCHAM—High-frequency oscillator detector (5997). Impulse excitation for Wireless Telegraphy (6449).
6682	March 16.	W. P. THOMPSON, for GES. FUR DRAHT. TEL., M.B.H.—Production of electric oscillations by direct currents.
7519	March 25.	MARCONI CO. and H. ROUND—Receivers for Wireless Telegraphy.

7582 March 27.—ERNEST O. WALKER—Spark generator for Wireless Telegraphy.

8236 April 1.—E. BOLL, G. ARNESEN, and A. W. SIZER—Wireless Telegraphy.

8387 April 4.—RUDOLF GOLDSCHMIDT—Method of and means for receiving electric waves.

8524 April 5.—BEDRICH MACKU—Arrangements for producing slightly damped electric oscillations.

8712 April 7.—GES. FUR DRAHTLOSE TELEGRAPHIE, M.B.H.—Arrangements for producing slightly damped electric oscillations.

8806 April 8.—SIR OLIVER LODGE and E. ROBINSON—Wireless Telegraphy.

9349 April 15.—WALTHER BURSTYN—Irradiance coils.

10266 April 27.—E. BELLINI and A. TOSI—Spark-gap device for Wireless Telegraphic and Telephonic apparatus.

10639 May 2.—R. C. GALLETTI—Production of quenched electric spark discharges.

10857 May 4.—HANS VON KRAMER—Inductive Wireless Telegraphic installations.

11109 May 8.—SIR O. LODGE and A. MUIRHEAD—Devices for preventing interference in Wireless Telegraphy.

11339 May 10.—ETTORE BELLINI—Transmitters and receivers for Wireless Telegraphic and Telephonic apparatus.

11407 May 17.—HERBERT MURRAY—Wireless Telegraph transmitting stations.

11999 May 18.—EMILE GIRARDEAU—Method of mounting, receiving and transmitting apparatus in radiotelegraphic stations.

12254 May 20.—R. S. P. HORNBY (12254) and H. ASHLEY
12255 MADGE (12255)—Transmitters for Wireless signalling.

13020 May 20.—G. MARCONI & MARCONI CO.—Installations for Wireless Telegraphy.

14028 June 13.—PERCY E. YOUNGS—Apparatus by the use of which it is possible to cause an electrical circuit to be made or broken at will from a distance by means of ether waves.

14727 June 21.—HERBERT MURRAY—Wireless Telegraphy.

14994 June 27.—T. McClelland de Bingham—Means of and apparatus for duplex Wireless Telegraphy.

15249 June 30.—Soc. Radio-Electrique, France—Antennae for the transmission and reception of Hertzian waves.

15718 July 6.—J. Erskine Murray—Wireless signalling.

17027 July 25.—Alexandre Vojen—Telephone receivers of
17028 the radiating field type (17027). Application of radio-active phenomena to Telephony (17028).

17149 July 26.—Geo. C. Dymond, Ges. fur Draht. Tel., M.B.H.—Electrical oscillation apparatus particularly adapted for Wireless Telegraphy.

17634 Aug. 3.—Hans von Kramer—Inductive Wireless Telegraphy and Telephony installations.

18231 Aug. 11.—Ges. fur Draht. Tel., M.B.H.—Electrical oscillation circuits and their connections.

18271 Aug. 12.—Wm. P. Ditcham—Transmitters for Wireless Telegraphy.

18284 Aug. 12.—H. Grindell Mathews—Improvements in Wireless Telephones applicable to Wireless Telegraphs.

18879 Aug. 22.—C. Wirth, C. Beck, and H. Knauss—Wireless Telegraphic apparatus.

19829 Sept. 6.—A. de Courcy Bower—Receiving apparatus for use in Radiotelegraphy and Telephony.

19948 Sept. 7.—Lucien Rouzet—Transmitting apparatus for Wireless Telegraphy.

21116 Sept. 25.—Horace Manders—Method and means of transmitting human speech and other sounds through space.

21639 Oct. 2.—F. L. Muirhead—Telephonic apparatus.

22079 Oct. 6.—A. T. M. Jonston, F. Varley, M. Michaelis, J. Power, and the Johnson Secret Wireless Telegraphy and Telephony Testing Syn.—Means of and apparatus for electrically transmitting and receiving messages.

22443 Oct. 11.—Oreste Angelini—Signals for use in Wireless Telegraphy.

22690 Oct. 14.—Ken. J. Balsillie—Variable speed power transmissions.

25216 Nov. 14.—Betulander—Automatic telephones (system).

25278 Nov. 14.—JOHN GARDNER—Wireless Telegraphy.

25718 Nov. 17.—H. GRINDELL MATHEWS—Improvements in Wireless Telephony applicable to Wireless Telegraphy.

26039 Nov. 21.—AKTIESELSKABET HOVLANDS RADIOTELEGRAF —Type-printing telegraph apparatus for line-telegraphy and radiotelegraph, having an arrangement for producing secret signal characters.

26153 Nov. 22.—MARCONI CO. and ENTWISTLE—Switches for high-tension electric currents.

27481 Dec. 7.—SYDNEY J. ALAVOINE—Wireless Telegraphy.

28351 Dec. 16.—H. HEINICKE and MAX. JASPER—Production and (wireless) transmission of electrical oscillations.

28634 Dec. 19.—E. DUCASSION & CO.—Witness-post with
28635 automatic regulator of radiation for emission of
28636 Hertzian waves (28634). Integrator receptor of Hertzian waves with telebolometer and rhythmograph (28635). Isocymogenic apparatus permitting the emission of steady waves in time and space (28636).

1912.

86 Jan. 1.—G. MARCONI and C. S. FRANKLIN—Wireless Telegraphic receivers.

2049 Jan. 25.—ALEX. MUIRHEAD and MUIRHEAD & CO.—Electric Telegraphy.

2383 Jan. 30.—GESELLSCHAFT FUR DRAHTLOSE TEL. M.B.H. —Receiving apparatus for electric oscillations.

2456 Jan. 30.—MARCONI'S WIRELESS TELEGRAPH CO. and
2457 CHAS. E. PRINCE—Aerial conductors used in Wireless Telegraphy (2456). Receiving apparatus for Wireless Telegraphy (2457).

2768 Feb. 2.—GESELLSCHAFT FUR DRAHTLOSE TELEG.
2769 M.B.H.—Spark gaps for use in electric circuits
2770 adapted for rapid electric oscillations (2768). Wireless Telegraphic installations (2769). Masts in use for Wireless Telegraphic installations (2770).

3054 Feb. 6.—MARCONI'S WIRELESS TELEGRAPH CO. and
3055 H. J. ROUND—Magnifying and detecting weak alternating currents (3054). Wireless Telegraphic receiving apparatus (3055).

3334 Feb. 9.—ETTORE BELLINI—Transmitters and receivers for Wireless Telegraphic and Telephonic apparatus.

3445 Feb. 12.—F. L. MUIRHEAD—Reception of call-up signals in Wireless Telegraphy.

3555 Feb. 12.—ALEX. HEYLAND—Method of apparatus for generating high-frequency currents.

3966 Feb. 16.—FERDINAND SCHNEIDER—Apparatus for the operation of electric clocks by electric waves.

4762 Feb. 26.—W. C. M. NICHOLSON and F. E. E. G. SCHRIEBER—Production of high-frequency oscillations.

5584 March 5.—C. H. GULLIVER—Wireless Telegraphy.

5904 March 8.—MARCONI'S WIRELESS TELEGRAPH CO., J. E. COCHRANE & R. D. BANGAY—Apparatus for Wireless Telegraphy.

6486 March 15.—W. DITCHAM, G. MATTHEWS and THE GRINDELL MATTHEWS' WIRELESS TELEGRAPH SYN.—Means of producing electro-magnetic waves of high group frequency and their adaptation to Wireless Telegraphy.

6498 March 15.—MARCONI'S WIRELESS TELEGRAPH CO. and R. H. WHITE—Internal combustion engines.

6987 March 21.—A. C. COSSER, LTD., and H. J. STENNING—Variable condenser.

7242 March 25.—F. J. CHAMBERS—Signalling by means of electro-magnetic waves.

8196 April 14.—WILLIAM DUBILIER—Improvements in or relating to high-frequency apparatus and induction coils.

8559 April 11.—GES. FUR DRAHT. TELEGRAPHIE, M.B.H.—Arrangements for determining position by means of electro-magnetic waves.

8598 April 17.—ARTHUR WEIGEL—Method of and device for neutralising the inertia of selenium cells.

9181 April 18.—ERICH F. HUTH, G.M.B.H.—Method of adjusting from a distance through the medium of periodic oscillations of different frequency.

9499 April 22.—SIEMENS & HALSKE AKT-GES.—Methods of and application for obtaining simultaneous radiographs.

9826 April 25.—EDWARD O'TOOLE—Wireless signalling and the like.

10111 April 29.—ANTON E. J. VLUG—Wireless Telegraphy.

10501 May 3.—WILFRED S. PEAKE—Wireless Telegraphic apparatus.

10558 May 3.—EUGENE V. GRATZE—Controlling or actuation of clocks and other recording or indicating mechanism by Wireless Telegraphy.

10701 May 6.—ALBERICO POSSOLO—Means for establishing communication (electrical) between ships and ships and shore.

10823 May 7.—TORIKATA, YOKOYAMA and KITAMURA—Oscillation gaps.

10863 May 7.—ROBERTO GALLETTI—Wireless signalling.

10911 May 8.—WILLIAM J. LYONS—Apparatus by means of which an electric circuit will be automatically closed at any particular station by the reception there only of a specially arranged number and sequence of telegraphic signals sent by Wireless Telegraphy or other method and capable of working a relay.

11091 May 9.—WILLIAM DUBILIER—Apparatus for producing electrical oscillations adapted for Wireless communication and other purposes.

11272 May 11.—J. THURSTON SIBLEY—Wireless Telegraphy and Telephony.

11479 May 14.—W. SHEPHARD and A. MCKECHNIE—Alarm device for use with Wireless Telegraph systems.

11582 May 15.—L. E. GABRIELOVITCH and W. S. DACHANPOLODOFF—Method of multiple Wireless Telegraphy, including independent tuning of each of several receivers connected to one antenna.

11671 May 16.—L. E. GABRIELOVITCH and W. S. DACHANPOLODOFF—Method of simultaneous transmission and reception of several messages from one antenna.

11703 May 16.—EMILE GIRARDEAU—Method of indirect excitation of oscillating circuits.

11714 May 16.—HERBERT MERTON.—Wireless Telegraphy and Telephony.

11868 May 18.—LONDROME SYN., LTD.—Receiving and transmitting apparatus for Wireless Telegraphy.

12444 May 25.—CAPT. DAN ZAHARIA and G. ROTHLANDER—Arrangements for receiving-station for Wireless Telegraphy.

12680 May 29.—FERDINAND SCHNEIDER—Apparatus for the operation of electric clocks by electric waves.

13218 June 5.—ARTHUR HONIG—Polarized electrical receiving instruments.

13301 June 6.—PHILIP G. DOUGLAS—Device for operating a signal distress at sea by Wireless Telegraphy.

13989 June 15.—T. RAYMOND PHILLIPS—Controlling plurality of apparatus by means of Hertzian waves.

14015 June 15.—WILLIAM DUBILIER—Wireless Telegraphy.

14390 June 19.—HERBERT S. JONES, GES. DRAH. TEL. M.—Method of and apparatus for the production of electric currents of high frequency.

14735 June 24.—VICTOR FALLON FEENY (NATIONAL WIRELESS TELEG. AND TELEPH. Co., New York)—Apparatus for the production of high-frequency oscillating currents.

16000 July 9.— E. FOURNIER D'ALBE—Instrument for discovering light by means of the ear.

16163 July 10.—LEON THIBAULT—Wave detectors for Wireless Telegraphy and Telephony.

16827 July 19.—GES. FUR DRAHTLOSE TELEGRAPHIE, M.B.H. —Method of producing electric oscillations for alternating currents.

16874 July 19.—GEORG SEIBT—Instruments for controlling the wave length or frequency of electric currents or measuring same.

16992 July 22.—C. GRAHAME WHITE and H. FOTHERGILL—Apparatus for the production of electric power for use in connection with Wireless Telegraphy and Telephony on aeroplanes and hydroplanes.

17443 July 27.—C. GRAHAME WHITE and H. FOTHERGILL—Apparatus for use on aeroplanes and hydroplanes for radiating and receiving electric waves in connection with Wireless Telegraphy and Telephony.

18086 Aug. 6.—FERDINAND SCHNEIDER—Receiving apparatus for electric waves.

18111 Aug. 6.—ARCHIBALD SHAW—Wireless Telegraphic transmitter.

18188 Aug. 7.—FERDINAND SCHNEIDER—Receiving apparatus for electric waves.

18422 Aug. 10.—JAMES T. SIBLEY—Wireless Telegraphy and Telephony.

18632 Aug. 14.—H. HEINICKE and MAX. JASPER—Production and wireless transmission of electrical oscillations.

19005 Aug. 19.—FRANCIS A. HERON—Means for utilising radiant energy for manufacturing from an object or objects material form in any substance, scale or relief required.

19014 Aug. 20.—FRANK JAMIESON—Wireless system to selectively call up station (without disturbing others) whether operator be in attendance or absent.

19763 Aug. 29.—WILLIAM DUBILIER—Apparatus for producing electric oscillations adapted for Wireless Telegraphy, etc.

20285 Sept. 5.—MARCONI Co. and C. S. FRANKLIN—Means for receiving Wireless Telegraphic signals.

21743 Sept. 24.—WM. SHEPHARD and A. MCKECHNIE—Wireless Telegraphic system.

21882 Sept. 26.—THOS. HOLROYD—Telescopic, teinoscopic deep-sea detachable observatory fitted (among other things) with Wireless Telegraphy.

22036 Sept. 27.—WM. SHEPHARD and A. MCKECHNIE—Alarm device in use with Wireless Telegraphy.

22805 Oct. 7.—CARL HANSSEN.—Antennae used for transmitting and receiving radio-electric waves for telegraphic messages or electric energy.

22875 Oct. 7.—KARL ROTTGARDT—Method of producing high-frequency oscillations.

22882 Oct. 8.—WM. H. WHITESIDE—Wireless telegraph control switch.

23458 Oct. 14.—WM. SHEPHARD and A. MCKECHNIE—Transmitting apparatus for use with Wireless Telegraph systems.

23734 Oct. 17.—RUDOLF GOLDSCHMIDT—Reception of electric waves.

27870 Oct. 18.—H. SEFTON JONES (JACOVIELLO SOCIETY, ITALY)—Device for transferring the energy of one electric oscillation to another by shock excitation.

24345 Oct. 24.—EMILE GIRARDEAU—Aerials for use in Wireless Telegraphy.

24937 Oct. 31.—COMP. UNIVERSELLE DE TELEG. ET TELEPH. S/F—Production of high-frequency currents adapted for use in Wireless Telegraphy and Telephony.

24999 Oct. 31.—WILLIAM H. MUGLESTON—Pole or standard for Wireless Telegraphy.

26457 Nov. 18.—OLIVER IMRAY, for COMP. GEN. RADIOTELEGRAPHIQUE—Device for adjusting the length of the spark gap between electrodes.

27934 Dec. 4.—GEO. HEYL and T. BAKER—Method of and means for directing wireless radiations.

28042 Dec. 5.—SAM. D. WILLIAMS—System of duplex Wireless Telegraphy.

28070 Dec. 5.—OLIVER IMRAY, for COMP. GEN. RADIOTELE-
28071 GRAPHIQUE—Circuit arrangements for the reception of signals transmitted by means of electromagneto waves (28070). Method of charging condensers in parallel and discharging them in series (28071).

28595 Dec. 11.—ROBERT KRAUSE—Appliances for producing electric oscillations.

28865 Dec. 14.—G. MARCONI—Wireless Telegraphic trans-
28866 mitters.

29268 Dec. 19.—SIR OLIVER LODGE and LIONEL LODGE—
29269 Unidirectional high-tension dischargers (29268). High-tension insulators (29269).

29375 Dec. 20.—COMPAGNIE GENERALE RADIOTELEGRAPHIQUE—Method of charging condensers in parallel and discharging them in series.

FRANCE.

1911.

425244 Jan. 26.—LANGE—Aerial conductor for Wireless Telegraphy and Telephony.

13736 Jan. 24.—BELLINI & TOSI—First addition to the
423261 patent of 10th Feb., 1910, for improvements in the antennae of Telegraphy and Wireless Telegraphy.

427101 March 9.—DR. ERICH F. HUTH, G.m.b.H. et HIRSCH—Wavemeter.

428594 April 10.—LAIR—Control post with automatic regulator for transmission of Hertzian waves.

428596 April 10.—LAIR—Integrating receptor of Hertzian waves with telebolometer and rythmograph.

428597 April 10.—LAIR—Isocymogenic arrangement permitting transmission of constant waves in time and space.

429155 Feb. 9.—LE GOARANT DE TOMELIN—Apparatus permitting exchange of radiotelegraph communication in voluntarily determined directions.

430316 May 30.—HUBERT—Rectifier of electric waves.

430637 June 6.—GOLDSCHMIDT—Arrangement for increasing the length of wave of antennae in radiotelegraphy.

432077 July 8.—GIRARDEAU—Arrangement of transmission for radiotelegraphic stations through direct excitation.

432078 July 8.—GIRARDEAU—Arrangement for automatic and instantaneous passage from transmission to reception in radiotelegraphic stations by direct excitation.

432725 July 28.—GES. FUR DRAHTLOSE TELEGRAPHIE m.b.H. —Oscillatory electric circuit specially applicable for Wireless Telegraphy apparatus.

433966 Aug. 23.—GIRARDEAU—Direct excitation magneto for radiotelegraphic stations.

434998 Oct. 7.—ANGELINI—New radiotelegraphic arrangement for the transmission of Morse by dots and dashes.

435291 Oct. 11.—DUROQUIER—Universal detector for Wireless Telegraphy receptors.

437423 Feb. 16.—TISSOT & PELLIN—Rapid regulating radiotelegraphic receptor.

437452 Dec. 11.—JASPER—Method and arrangement for producing and transmitting waves by Wireless Telegraphy.

437693 Dec. 15.—MATTHEWS—Portable Wireless Telegraphy apparatus.

438080 Nov. 8.—POST—Conducting aerial apparatus for Wireless Telegraphy and Telephony.

438289 March 11.—GIRARDEAU—Improvements in radiotelegraphic stations furnishing musical transmissions by means of relatively high-frequency alternators.

438556 Dec. 2.—VARLEY—Improvements in apparatus for establishing and interrupting electric contacts in systems of Wireless signal transmitting.

438816 March 24.—PELLIN—Radiotelegraphic receptor for Wireless Telegraphy and Telephony.

438961 March 27.—JEGOU—Arrangement for preventing the hourly receptions from discovering the radiotelegraphic messages.

440509 May 4.—BELLINI—Improvements in Wireless Telegraph installations.

1911.

15372 Jan. 29.—JEGOU—First addition to the Patent 418663
418663 of July 28th, 1910, for receptor for hourly Hertzian signals and radiotelegraph messages.

441050 March 7.—DUROQUIER—Detector of solid contact waves for Wireless Telegraph receptors.

441219 March 12.—LA RADIO ELECTRICITE—Improvements in Wireless Telegraphy apparatus.

441318 March 13.—GIRARDEAU—Procedures for regulating electrogenic groups employed in radiotelegraphy.

441959 March 30.—BULL, ARNESEN & SIZER—Improvements in Wireless Telegraphy.

441960 March 30.—DOSNE—System of utilising telephonic and telegraphic aerial lines as reception antennae in Wireless Telegraphy.

442264 April 6.—LODGE & ROBINSON—Improvements in Wireless Telegraph and Telephone apparatus.

443725 May 11.—ERSKINE MURRAY—Improvements in the transmission of signals by Wireless Telegraphy.

443753 May 13.—MARCONI'S WIRELESS TELEGRAPH CO., LTD. —Arrangements for the simultaneous transmission and reception of messages in one Wireless Telegraph station.

444117 May 22.—TORCHATA, YOKOYAMA & RITAMURA—Improvements in oscillators or excitors for radiotelegraphy, radiotelephony, and other analogous applications.

444250 May 24.—THIBAULT—Wave detector for Wireless Telegraphy and Telephony.

444723 June 7.—BEAUDON—Relay for Wireless Telegraphy.

445034 June 15.—GIRARDEAU—Reception jigger for radiotelegraphic stations.

445349 June 24.—MORETTI—Electric coupling for radiotelegraphic and radiotelephonic purposes.

445413 June 25.—NATIONAL WIRELESS TELEPHONE AND TELEGRAPH CO.—Apparatus for production of alternative high-frequency currents for Wireless Telegraphy and Telephony.

445821 July 4.—TURPIN—System of transmittor-receptor of Hertzian waves.

446257 July 19.—ZAHARIA & RATLENDER—Receptor apparatus for Wireless Telegraphy.

GERMANY.

1911.

230484 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, m.b.H., Berlin—Enclosed spark-gap for the production of electric oscillations.

231440 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, m.b.H. —Detector for electric oscillations.

231691 MARCONI'S WIRELESS TELEGRAPH CO., LTD., London—Method for wireless duplex operations.

231963 DR. BRUNO GLATZEL, Berlin—Method for the production of high-frequency currents on the principle of the impulsive excitation.

231974 DR. PAUL LUDOVIG, Frankfurt a/M.—Meter for measuring the damping in Wireless Telegraphy.

232174 EGBERT VON LEPEL, Berlin—Method for the production of rapid electric oscillations from continuous or alternating currents.

232332 FESSENDEN, R. A., Brant Rock, Mass., U.S.A.—Arrangement for transmitting wireless signals to or from free-flying air-craft.

232941 DR. BRUNO GLATZEL, Berlin—Method for the production of high-frequency currents on the principle of impulsive oscillation; supplement to Patent No. 231963.

232942 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Method for receiving damped oscillations; supplement to Patent No. 219996.

232943 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Antenna supplement to Patent No. 229338.

233152 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for receiving wireless messages.

233288 Dr. A. Korn, Berlin—Electric wireless transmismission of handwriting, drawings, and other graphical diagrams, as well as half-tone engravings, whereby the Balkewell Transmitter is used.

233462 Gesellschaft fur Drahtlose Telegraphie, Berlin—The driving of the movable parts of tuning apparatus, such as revolving condenser, variometer, and the like, especially for the purposes of Wireless Telegraphy.

235013 Fessenden, R. A., Brant Rock, Mass., U.S.A.—Arrangement for the production of electric oscillations.

235869 C. Lorenz, A.g., Berlin—Method for the production of high-frequency currents.

235881 C. Lorenz, A.g., Berlin—Coupling arrangement for the receiving apparatus of Wireless Telegraphy.

236327 Fessenden, R. A., Brant Rock, Mass., U.S.A.—Method for the transmission of wireless signals.

237168 Gesellschaft fur Drahtlose Telegraphie, Berlin—Mode of procedure of Wien's method for the production of electric oscillations by means of an alternating current of a high period; supplement to Patent No. 222832.

237177 Gesellschaft fur Drahtlose Telegraphie, Berlin—Brushes, especially for variable coils of Wireless Telegraphy.

237264 C. Lorenz, A.g., Berlin—Arrangement for regulating the speed of high-frequency machines.

237456 A. Blondel, Paris—Method for determination of the direction of propagation of Hertzian waves, by the employment of several open or closed frames arranged in different fixed directions, for the reception of waves.

237565 Bethenod, J. F. J., Paris—Alternating current machine for the production of alternating currents, the frequency of which is within the range of the audible tones, especially for the purposes of Wireless Telegraphy.

237714 C. Lorenz, A.g., Berlin—Arrangement for the production of sounding signals for the purposes of Wireless Telegraphy, by means of a continuous current.

237729 Gesellschaft fur Drahtlose Telegraphie, Berlin—Series spark-gap for the production of rapid electric oscillations, according to Wien's method, consisting of opposed flat-formed electrodes.

237741 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the production of high-frequency electric oscillations.

237757 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Procedure for the manufacture of coils for the high-frequency technic.

237809 WIRELESS TELEGRAPHY AND TELEPHONY COMPANY (System S. Eisenstein), St. Petersburg—Quenched spark-gap.

237815 WIRELESS TELEGRAPHY AND TELEPHONY CO. (System S. Eisenstein), St. Petersburg—Arrangement for the production of electric impulse charges, for the purposes of Wireless Telegraphy and Telephony.

237845 ERNST RUHMER, Berlin—Arrangement for the production of trains of damped electric oscillations.

237931 C. LORENZ, A.g., Berlin—Arrangement for cooling coils of the high-frequency technic.

237933 FERD. SCHNEIDER, Fulda—Coherers.

238001 WIRELESS TELEGRAPHY AND TELEPHONY CO. (System S. Eisenstein), St. Petersburg—Arrangement for the production of electric impulse charges, for the purposes of Wireless Telegraphy and Telephony.

238113 SIGNAL-GESELLSCHAFT, m.b.H., Kiel—Arrangement for production of a strengthened repetition of alternate current oscillations of a definite frequency.

239325 DR. BRUNO GLATZEL, Berlin—Procedure for the production of high-frequency currents, on principle of impulsive excitation.

239662 FRITZ KUPPELMAYER, Munich—Arrangement for Wireless Telegraphy.

239663 BELLINI, ETTORE, AND ALESSANDRO TOSI, Paris—Antennæ in distant Wireless Telegraphy and Telephony.

240517 DR. ING. RUDOLF GOLDSCHMIDT, Charlottenburg, Berlin—Method for reception of electric waves.

240798 GIRARDEAU, EMILE, Paris—High-frequency alternating current machine for Wireless Telegraphy and Telephony.

240799 GIRARDEAU, EMILE, Paris—Reception and transmission arrangement for wireless stations.

240800 DR. JOSEPH SCHIESSLER, Baden (near Vienna)—Arrangement for the production, strengthening, and

reception of the utmost possible non-damped electric oscillations.

240928 SACEK, JOHANN, Prague—Arrangement for ensuring secrecy in Wireless Telegraphy communications.

241031 DR. JOSEPH SCHIESSLER, Baden (near Vienna)—Arrangement for the production of high-frequency (nearly) non-damped electric oscillations.

241114 DR. GEORGE SEIBT, Berlin—Production of weak damped oscillations.

241577 HANS BOAZ, Berlin—Multiple spark-gap for impulse excitation produced by turning a helical spindle.

241578 C. LORENZ, A.g., Berlin—Arrangement of the connections for wireless stations.

241718 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for switches on Wireless Telegraphy stations.

241769 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Contact detector for electric oscillations.

241947 DR. ERICH F. HUTH, G.m.b.H., Berlin—Reception procedure for wireless communications.

242110 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Transmitter fed with alternating current for sounding sparks.

242111 DR. LUIGI CEREBOTTANI, Munich—Arrangement for obtaining a regular intermittent movement, by means of using electric waves, in printing telegraphy and in voluntary wireless signalling.

242648 DR. ERICH HUTH, G.m.b.H., Berlin, and RICHARD MARSH—Arrangement for determining the length of waves, and for the observation of oscillations in an electric oscillation system, by using a closed oscillatory circuit with variable electrical quantities, which circuit must be joined to the system to be examined.

242649 HANS BOAZ, Berlin—Wave meter.

1912.

242956 FESSENDEN, R. A., Brant Rock, Mass., U.S.A.—Arrangement for the reception of electric oscillations.

243241 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the reception of electric oscillations.

243417 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the strengthening of current variations of small amplitude, in which the variations act on a

Dr. Ed. Branly.

[To face page 508

relay with microphone-like contact, especially for the purposes of Wireless Telegraphy.

243860 Dr. Ing. Rudolf Goldschmidt, Berlin—Procedure for the production and strengthening of alternating currents for the purpose of transmission and reception in Wireless Telegraphy.

243861 American District Telegraph Co., Jersey City—Alternating current relay with an anchor arranged to revolve, and tuned to the frequency of the alternating current.

243955 Gesellschaft fur Drahtlose Telegraphie, Berlin—Variable self-induction, especially for the purpose of Wireless Telegraphy.

244092 Fessenden, R. A., Brant Rock, Mass., U.S.A.—Electric receiver and indicator, especially for the purpose of Wireless Telegraphic communication.

244093 Fessenden, R. A., Brant Rock, Mass., U.S.A.—Electric receiver and indicator; supplement to Patent No. 244092.

244169 Fessenden, R. A., Brant Rock, Mass., U.S.A.—Procedure and arrangement for the transmission of signals by means of electro-magnetic waves.

244416 Dr. Joseph Schiessler, Baden (near Vienna)—Arrangement for syntonised Wireless Telegraphy and Telephony.

244687 Gesellschaft fur Drahtlose Telegraphie, Berlin—Arrangement for reception of electric waves.

244744 Dr. Karl Rottgardt, Charlottenburg, Berlin—Procedure for the production of high-frequency oscillations.

244780 Dr. Erich F. Huth, G.m.b.H., Berlin—Arrangement for the production of non-damped electric oscillations.

244845 Ernest Wilson, London, and William H. Wilson, Norbiton, Surrey, England—Method and arrangement for the production of discharges with high voltage.

244846 Gesellschaft fur Drahtlose Telegraphie, Berlin—Insulating layer for the spark-gap in Wireless Telegraphy.

244883 Dr. Joseph Schiessler, Baden (near Vienna)—Capacity inductive coupling.

245358 Robert Clemens Galletti, Rome—Method and arrangement for the production of unbroken wave trains by means of primary circuits.

245431 Gesellschaft fur Drahtlose Telegraphie, Berlin—Transmitting and reception station for Wireless Telegraphy.

245445 Dr. Ing. Rudolph Goldschmidt, Berlin—Procedure for the production of periodic energy variations in high-frequency machines for the purpose of tone sending in Wireless Telegraphy.

245652 Jeance, Paris, and Victor Colin, Neuilly s/Seine—Arrangement for the transmission of tones of all kinds, by the production of continuous non-damped oscillations brought about by a supply of continuous current and one or several electric arcs.

245715 Max. Jasper, Schoneberg, Berlin—Production of weak damped electric oscillations by means of a double-acting vacuum breaker.

246018 Dr. Erich F. Huth, Berlin—Ignition arrangement in electric arc generators of electric oscillations.

246244 Dr. Walther Burstyn, Berlin—Procedure in dealing with strong electric currents.

246866 Dr. Erich F. Huth, Berlin—Ticker for reception of non-damped oscillations in which the movable ticker contact is made fast to a membrane.

246910 Peder Oluf Pedersen, Frederiksberg, Denmark—Transmitting apparatus for automatic electric signalling.

247718 Gesellschaft fur Drahtlose Telegraphie, Berlin—Series spark-gap for the production of rapid electric oscillations.

248040 Dr. Walther Burstyn, Berlin—Method for the production of electric oscillations on the principle of impulse excitation.

248124 Fessenden, F. A., Brant Rock, Mass., U.S.A.—Receiver for electro-magnetic waves.

247274 C. Lorenz, A.g., Berlin—Aerial conductor for Wireless Telegraph transmission.

248198 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Antennæ for Wireless Telegraphy and Telephony.

248205 C. LORENZ, A.g., Berlin—Arrangement for the production of tone signals for the purposes of Wireless Telegraphy.

248479 HEIN, LEHMANN & CO., A.g., Berlin—Iron mast for Wireless Telegraphy.

248684 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Metal box for reception of coils in Wireless Telegraphy.

249075 E. BROWMAN, Elmwood, Ontario, Canada—Arrangement for calling neighbouring stations by means of frequency currents of definite number of periods.

249627 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Variable self-induction, especially for the purpose of Wireless Telegraphy.

248711 DR. GEORGE SEIBT, Schoneberg, Berlin—Pair of electrodes working as an electric arc, as current-breaker, or as quenched spark-gap.

249730 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement of aerial conductor in Wireless Telegraphy.

249801 WIRELESS TELEGRAPH AND TELEPHONE CO. (System S. Eisenstein), St. Petersburg—Arrangement for the production of electric impulse discharges in Wireless Telegraphy and Telephony.

249845 DR. GEORGE SEIBT, Berlin—Connection system for wireless signal receiving stations and method of working same.

251945 THE AMERICAN TRANSMITTER AND MANUFACTURING CO.—Automatic telegraph transmitter with key board.

252908 C. LORENZ, A.g., Berlin—Tin casings for the high-frequency technic.

253117 DR. GEORGE SEIBT, Schoneberg, Berlin—Quenched spark-gap.

253164 R. S. KOGEL, Wessobrun, Bavaria—Arrangement for recording electric waves by means of the Morse Recorder.

253232 DR. ING. RUDOLF GOLDSCHMIDT, Berlin—Method for

the improvement of Wireless Telegraphy with tones, and of Wireless Telephony by using high-frequency generators as source of energy.

254175 HANS BOAZ, Berlin—Spark-gap for the production of highly damped oscillations.

254176 ROBERT KRAUSE, Berlin—Enclosed spark-gap for the production of electric oscillations.

254242 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for continuously altering the self-induction, especially for the purposes of high-frequency technic.

254347 EMILE GIRARDEAU, Paris—Aerial conductor in wire form for Wireless Telegraph stations with generators of high-frequency alternating currents.

254383 DR. ERICH F. HUTH, G.m.b.H., Berlin—Method of receiving wireless signals.

254384 DR. ERICH F. HUTH, Berlin—Arrangement for the determination of the wave-lengths, and observation of the oscillation incidents.

254463 EGBERT VON LEPEL, Paris—Method of connection for the production of rapid electric oscillations from continuous or alternating currents.

254564 C. LORENZ, A.g., Berlin—Arrangement for connection in parallel of several microphones for the working with high-frequency alternating currents.

254524 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the production of electric oscillations by means of an uninterrupted continuous current.

254586 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the interruption of continuous current, especially for the production of electric oscillations.

254587 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Contact detector for electric oscillations.

254656 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Testing arrangement for Wireless Telegraph stations.

254682 HEIN, LEHMANN & CO., A.g., Berlin, Reinickendorf—Suspension of aerial conductors for radiotelegraphic stations.

254782 KARL SCHIKTANZ, Charlottenburg, Berlin—One or multiphase homopolar alternating current machine of high-frequency.

254795 MORKRUM COMPANY, Chicago—Receiver for an electric selector system with which permutations of different current impulses are used for the selection.

255241 C. LORENZ, A.g., Berlin—Tin casings for the high-frequency technic; supplement to Patent No. 252908.

255674 GESELLSCHAFT FUR DRAHTLOSE TELEGRAPHIE, Berlin—Arrangement for the transmission of energy to a receiving circuit for electric oscillations.

255675 DR. RUDOLF GOLDSCHMIDT, Berlin—Method for the production and strengthening of alternating currents, especially for the purposes of sending and receiving in telegraphy and telephony; supplement to Patent No. 243860.

UNITED STATES, 1911.

Number.	Date. Inventor.
984108	Feb. 14.—O. C. ROOS.
984762	Feb. 21.—F. A. HART.
985854	March 7.—W. E. D. STOKES, JUNR., and G. W. DAVIS.
986405	March 7.—P. O. PEDERSEN.
986651	March 14.—J. S. STONE.
986806	March 14.—R. D'ANTONIO.
991837	May 9.—S. EISENSTEIN.
992042	May 9.—M. A. PARISANO.
992791	May 23.—J. F. MCELROY.
993024	May 23.— E. J. BURKE.
993316	May 23.—G. W. PICKARD.
994426	June 6.—R. H. RENDAHL.
995339	June 13.—L. DE FOREST.
996580	June 27.—C. M. GREEN.
996092	June 27.—M. B. JOHNSON.
996090	June 27.—M. B. JOHNSON.
996088	June 27.—M. B. JOHNSON.
996089	June 27.—M. B. JOHNSON.

997515	July 11.	—H. Shoemaker.
997516	July 11.	—H. Shoemaker.
998567	July 18.	—R. A. Fessenden.
1001227	Aug. 27.	—Stokes & Davis.
1001227	Aug. 22.	—Stokes & Davis.
1002141	Aug. 29.	—R. A. Fessenden.
1002051	Aug. 29.	—R. A. Fessenden.
1002049	Aug. 29.	—R. A. Fessenden.
1002050	Aug. 29.	—R. A. Fessenden.
1003374	Sept. 12.	—Schloemilch & Pichon.
1003210	Sept. 12.	—Schloemilch & Pichon.
1003375	Sept. 12.	—Schloemilch & Pichon.
1004748	Oct. 3.	—J. L. Creveling.
1005388	Oct. 10.	—H. Shoemaker.
1005471	Oct. 10.	—R. H. Rendahl.
1006786	Oct. 24.	—G. S. Piggott.
1011777	Dec. 12.	—J. Harden.
1006635	Oct. 24.	—L. De Forest.
1006636	Oct. 24.	—L. De Forest.
1008977	Nov. 14.	—T. H. Lyon.
1009106	Nov. 21.	—H. Shoemaker.
1009317	Nov. 21.	—M. B. Johnson.
1010669	Dec. 5.	—D. McF. Moore.
1012456	Dec. 19.	—G. Seibt.
1012496	Dec. 19.	—C. Wirth.

COMMERCIAL COMPANIES

The information given below relates to some of the leading companies commercially engaged in Wireless Telegraphy

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Marconi's Wireless Telegraph Company, Limited

Incorporated.—July 20th, 1897, as Wireless Telegraph and Signal Co., Ltd.; name changed as above in March, 1900.

Head Office.—Marconi House, Strand, London, W.C.

Directors.—Commendatore G. Marconi, LL.D., D.S. (Chairman), Godfrey C. Isaacs (Managing Director), Major S. Flood-Page, H. S. Saunders, Samuel Geoghegan, M.I.M.E., M.I.C.E.I., Captain H. Riall Sankey, R.E. (ret.), Alfonso Marconi, Colonel Albert Thys, Mons. M. Travailleur.

Secretary.—Henry W. Allen, F.C.I.S.

Formed to acquire Mr. Guglielmo Marconi's patents for Wireless Telegraphy in all countries except Italy, its colonies and dependencies. The Company holds, *inter alia,* 198,790 fully-paid £1 shares in Marconi International Marine Communication Co., Ltd.; 157,740 fully-paid $5 shares, series "AA," and 78,250 $5 shares (35 per cent. paid), series "BB," in the Cia Marconi Telegrafia sin Hilos del Rio de la Plata; 447,340 fully-paid $5 shares in the Marconi Wireless Telegraph Company of America; and 414,855 fully-paid $5 shares in the Marconi Wireless Telegraph Company of Canada, Ltd. In October, 1911, the Company took over the patents of the Lodge-Muirhead Syndicate, Ltd. The Company has in hand important contracts for the erection of Wireless Telegraph stations in nearly every part of the world. Some of the most important agreements are with the Norwegian, Portuguese, Brazilian, and Bolivian Governments. The Company owns the high-power Wireless Telegraph stations at Clifden, Ireland, and Poldhu, Cornwall, and is erecting other high-power Wireless Telegraph stations on its own behalf and for account of its subsidiary companies in England, New York, San Francisco, Honolulu, Buenos Aires, etc. In 1912 the Company erected new and extensive works at Chelmsford to enable it to cope with its rapidly increasing business.

Accounts and Dividends.—Accounts are made up at December 31st, and usually submitted in June following. Interim dividends of 5 per cent. (actual) were paid on the Ordinary shares on September 1st, 1911, and February 1st, 1912. Final dividend, for the year 1911, was paid on August 1st, 1912, of 10 per cent. (making 20 per cent. in all). Interim dividend of 10 per cent. (actual) was paid on August 1st, 1912. For the year 1911 the Preference shares received a total dividend of 17 per cent., and received an interim dividend of 7 per cent. in respect of the year 1912, on August 1st, 1912.

Capital.—Authorised and issued, £1,000,000 in 750,000 Ordinary shares of £1 each, and 250,000 Cumulative Participating Preference shares of £1 each. The Preference shares are entitled to a cumulative dividend of 7 per cent., and, after the Ordinary shares have received a 10 per cent. non-cumulative dividend, to share *pari passu* with the latter shares in surplus profits remaining.

The Marconi International Marine Communication Company, Limited

Incorporated.—April 25th, 1900.

Head Office.—Marconi House, Strand, London, W.C.

Directors.—Commendatore G. Marconi, H. S. Saunders, M. Travailleur, Major S. Flood-Page, Alfonso Marconi, Captain H. R. Sankey, R.E. (ret.), G. C. Isaacs (Managing Director).

Secretary.—H. W. Allen, F.C.I.S.

Formed for the purpose of working throughout the world, except in the United States of America, Hawaii, Chili, and colonies or dependencies of those States, an exclusive licence for all maritime (being mercantile or yachting) purposes granted by Marconi's Wireless Telegraph Company, Ltd. The Company has transferred to Associated Companies its rights in Canada, Argentina, Uruguay, and all European countries and their Dependencies except Great Britain and Ireland and Italy. In 1909 the Company and Marconi's Wireless Telegraph Company, Ltd., entered into an agreement with the Post Office, which provides, in consideration of the payment of £15,000 for the transfer to the Post Office of the coast stations in the United Kingdom.

Dividends.—5 per cent. for 1910; 7 per cent. for 1911.

Capital.—Authorised, £350,000 in £1 shares. Issued, £204,056 in 204,056 shares fully paid. Five-and-a-half per cent. First Mortgage Debentures (Bearer). Authorised, £250,000. Issued and outstanding, £125,000 in £20 bonds. Secured (without trust deed) as a floating charge on the undertaking and all the property. Redeemable at par July 1st, 1941. Interest payable January 1st and July 1st. At December 31st, 1912, this Company owned and operated the Wireless Telegraph apparatus on 639 vessels of the mercantile marine.

Marconi Wireless Telegraph Company of America

Incorporated.—November 8th, 1899, under the laws of New Jersey.

Head Office.—15, Exchange Place, Jersey City.

NEW YORK OFFICE.—Lords Court Building, 27, William Street, New York, U.S.A.

Directors.—J. W. Griggs (President), Commendatore G. Marconi, Godfrey C. Isaacs, John Bottomley, Kenneth K. MacLaren (temporary), James W. Pyke, John L. Griggs (temporary), Edward L. Young, James R. Sheffield, Major S. Flood-Page, James M. Townsend, George S. de Sousa.

Secretary and Treasurer.—John Bottomley.

Capital.—Reduced on April 18th, 1910, from $6,650,000 in 66,500 shares of $100 each to $1,662,500 in 66,500 shares of $25 each. Capital increased to $10,000,000, divided into 2,000,000 shares of $5 each, April 18th, 1912. Special settling day on the London Stock Exchange, June 19th, 1912, in 2,000,000 shares. The financial year ends at January 31st in each year. No dividends have yet been paid. Credit balance at January 31st, 1912, $15,238. The Company has the sole right to use and exploit the Marconi patents in the United States of America, the Hawaiian Islands, Philippine Islands, Cuba, Porto Rico, Alaska, and the Aleutian Islands. The Company owns 60 land stations, including a high-power station at Cape Cod, and at December 31st, 1912, owned and operated the wireless apparatus on 439 ships of the Mercantile Marine. The whole of the physical assets of the United Wireless Telegraph Co. in the United States were acquired by the American Marconi Company in April, 1912. The Marconi Wireless Telegraph Company of America is now making arrangements to erect high-power Wireless Telegraph stations for com-

munication between New York and Great Britain and Norway, and also to communicate from New York to San Francisco, the Hawaiian Islands, the Philippines, China, and Japan, and from New York to Cuba, Panama, and subsequently with each of the South American States. The Company has executed several large orders for the United States Government. The American Marconi Company is party to an agreement with the Western Union Telegraph Company of the United States and the Great North-Western Company of Canada, under which it has the use of the 25,000 telegraph offices of these two cable companies in the United States and Canada for the collection and delivery of Marconigrams.

Marconi Wireless Telegraph Company of Canada, Limited

Incorporated.—By special Act of the Dominion of Canada on August 13th, 1903.

Head Office.—Montreal.

Directors.—Commendatore G. Marconi, Andrew A. Allan, Robert Bickerdike, M.P., G. M. Bosworth, J. N. Greenshields, Godfrey C. Isaacs, W. D. Birchall, J. H. Lauer (General Manager).

Secretary and Treasurer.—A. E. Reoch.

Capital.—Authorised and issued capital, $5,000,000 in 1,000,000 shares of $5 each, fully paid. Special settling day on the London Stock Exchange, March 22nd, 1912, in 1,000,000 shares. The financial year of the Company ends at January 31st, in each year. No dividends have yet been paid. Credit balance at January 31st, 1912, $21,025.

Rights.—The Company owns the sole right to use and exploit the Marconi patents in the Dominion of Canada and the Colony of Newfoundland.

Principal Agreements.—Agreement concluded on April 5th, 1911, with the Canadian Government, whereby the Canadian Government purchased the wireless stations at Montreal and Three Rivers, and ordered a station to be built at Magdalen Islands. The Agreement also provided for the Marconi Company to operate and maintain on behalf of the Canadian Government the Wireless Telegraph stations on the eastern coasts of Canada, twenty in all, for a period of twenty years. On September 17th, 1912, a further Agreement was entered into with the Canadian

Government providing for the Marconi Company to operate and maintain, on behalf of the Canadian Government, nine Wireless Telegraph stations on the Great Lakes. This Agreement to run concurrently with the one concluded on April 5th, 1911. The Company receives, under the above two Agreements, subsidies totalling $92,700 per annum. An Agreement between the Newfoundland Government and the Company came into force on April 20th, 1912, under which the Canadian Marconi Company has an exclusive licence to work Wireless Telegraph stations in the Colony of Newfoundland. The Agreement also provides for the Company to operate eight Wireless Telegraph land stations on behalf of the Government, and to erect and operate four further such stations. The Marconi Wireless Telegraph Company of Canada, Limited, owns the high-power Wireless Telegraph station at Glace Bay, by which, in conjunction with the station at Clifden, Ireland, a public Wireless Telegraph service is conducted with Great Britain and the Continent of Europe. At December 31st, 1912, the Company owned and operated the Wireless Telegraph apparatus on fifty-one vessels.

The Canadian Government granted a subsidy of $80,000 towards the cost of erecting the Glace Bay station.

The Spanish and General Wireless Trust, Limited

Incorporated.—February 16th, 1912.

Head Office.—Marconi House, Strand, London, W.C.

Directors.—Godfrey C. Isaacs (Managing Director), Alfonso Marconi, Major S. Flood-Page, Captain H. Riall Sankey, Henry S. Saunders.

Secretary.—Henry W. Allen, F.C.I.S.

Capital.—Authorised, £350,000 in 350,000 shares of £1 each. Issued, 249,007 shares of £1 each. At December 31st, 1912, the first financial year of the Company not having been completed, no report had been issued concerning the results to be expected. The object of the Company is to acquire shares in some of the subsidiary Marconi Companies, in particular those of the Compania Naciońal de Telegrafia sin Hilos, the denomination of whose shares renders them difficult to negotiate on the London Stock Exchange. The Company held at December 31st, 1912, 12,350 Bearer shares of 500 pesetas each in La Compania Naciońal de Telegrafia sin Hilos.

Compagnie de Telegraphie Sans Fil

(Société Anonyme).

Incorporated.—October 26th, 1901.

Head Office.—13, Rue Brederode, Brussels, Belgium.

Directors.—Commendatore G. Marconi, Godfrey C. Isaacs, Emile Francqui, Colonel Albert Thys, Baron de la Chevreliere, M. Travailleur, Major S. Flood-Page, Charles Balser, Gaston Perier.

Secretary.—Monsieur Gaston F. Perier.

Capital.—Fcs. 300,000 consisting of 600 shares of Fcs. 500 each, and 500 Founders' shares of no capital denomination. The financial year ends at December 31st in each year. Dividends at the rate of 10 per cent. per annum have been paid on the capital shares for each of the years 1909, 1910, and 1911. The Company holds an exclusive licence to work the Marconi patents for maritime business in all countries of the Continent of Europe (France and Italy excepted), their colonies and dependencies, also exclusive rights in Belgium, Holland, Germany, Austria-Hungary, Denmark, Norway, Sweden, and Switzerland, for all purposes of land communication by Wireless Telegraphy on the Marconi system, excepting communication between fixed points over distances exceeding 1,000 km. (This exception does not apply to communications between Denmark and Iceland or between islands of the Dutch East Indies, irrespective of distance.) The number of ships carrying Wireless Telegraphic apparatus operated and controlled by the Company at December 31st, 1912, was 125. This Company has a large share-holding in the Deutsche Betriebs Gesellschaft fur Drahtlose Telegraphie m.b.H. of Berlin.

Deutsche Betriebs Gesellschaft fur Drahtlose Telegraphie m.b.H.

Incorporated.—January 14th, 1911.

Head Office.—Tempelhofer Ufer 9, Berlin, S.W. 61.

Directors.—Dr. Franke, Conseiller de Commerce Mamroth, Commendatore G. Marconi, Colonel A. Thys, M. Travailleur, Comte Georges d'Arco, Fritz Rose..

Vice-Directors.—Godfrey C. Isaacs, Dr. Paul Jordan, Gaston Perier, Prof. Dr. August Raps, Lieutenant Karl Solff, G. E. Turnbull.

Secretary and Manager.—Hans Bredow.

Capital.—900,000 Mks. Owing to the strenuous competition and other circumstances which obtained in Germany, an agreement was entered into by the Belgian Marconi Company and the German Telefunken Company in 1910, under which all the mercantile vessels in Germany, flying the German flag, fitted with either the Telefunken or Marconi system, were transferred to a new company, entitled the Deutsche Betriebs Gesellschaft fur Drahtlose Telegraphie m.b.H. This Company now holds licences from the Marconi and Telefunken Companies (for maritime purposes only), and carries on the whole of the mercantile business formerly carried on in Germany by those Companies. The system of Wireless Telegraphy installed by them is known as the "Debeg." At December 31st, 1912, the "Debeg" owned and operated the Wireless Telegraphic apparatus on 150 vessels. The financial year of the Company ends at September 30th in each year.

Dividends.—4 per cent. paid on first year's working.

Compagnie Française Maritime et Coloniale de Télégraphie Sans Fil

Incorporated.—April 24th, 1903.

Head Office.—35, Boulevard des Capucines, Paris, France.

Directors.—Baron de la Chevreliere, John Dal Piaz, Alfred Musnier, Charles Roux, Commendatore G. Marconi.

Secretary.—Monsieur L. Prioult.

Capital.—Fcs. 100,000 in 1,000 shares of Fcs. 100 each, fully paid, and 200 Profit shares having no capital denomination. The financial year of the Company ends at December 31st in each year. Dividends at the rate of 5 per cent. per annum have been paid on the capital shares of the Company in respect of each of the years 1906, 1907, 1908, 1909, 1910, and 1911. The Company owned and operated the Wireless Telegraph apparatus on 46 vessels at December 31st, 1912.

Rights.—The Company holds the exclusive Licence of Marconi's Wireless Telegraph Company, Limited, and the Marconi International Marine Communication Company, Limited, for France, its colonies and dependencies, and vessels flying the French flag.

Compañia Nacional de Telegrafia Sin Hilos de Espana

Incorporated.—December 24th, 1910.

Capital.—6,500,000 pesetas divided into 8,000 6 per cent. Participating Preference shares of 500 pesetas each and 5,000 Ordinary shares of 500 pesetas each.

Head Office.—Calle de Alcala 43, Madrid.

Directors.—Commendatore G. Marconi, Godfrey C. Isaacs, Excmo. Sr. Don Jose Sanchez Guerra, Excmo. Sr. Conde de Albiz Don Antonio Comyn, Excmo. Sr. Marquis L. Solari, Excmo. Sr. Don. Lorenzo Alonso Martinez, Sr. Don Federico Rohr, Sr. Jose Bertram y Musitu, Sr. Francisco Setuain, Sr. Eduardo Estelat, Exco. Sr. General Don Jose de Bascaran, Sr. Don Jaime Macnaughton.

Secretary.—Don Pablo Figuerola Ferretti.

The financial year ends on December 31st in each year. No dividend has yet been paid. This Company was formed to take over from La Compania Concesionaria de Servicio Publico Espanol de Telegrafia sin Hilos, who were unable to carry out their obligations, the concession from the Spanish Government for the construction and exploitation of a public Wireless Telegraph service in Spain and its colonies. The Company has seven Wireless Telegraph land stations erected and working at Aranjuez, near Madrid, Cadiz, Barcelona, Teneriffe, Las Palmas, Vigo, and Soller, and has further stations in course of construction at Finesterre, Santander, Cape Galos, Valencia, Malaga, and Huelva. The Company holds an exclusive licence from Marconi's Wireless Telegraph Company, Limited, to use and exploit its patents in Spain and her colonies, except on vessels of the Mercantile Marine.

Russian Company of Wireless Telegraphs and Telephones

Incorporated.—October 8th, 1908.

Head Office.—14, Lopuchinskaia, St. Petersburg, Russia.

Directors.—Commendatore G. Marconi, G. C. Isaacs, G. M. Tischenko, S. M. Eisenstein, Pierre de Balinski, M. Salberg (Alternative Director), Adrian Simpson (Managing Director).

Secretary.—Leon Eisenstein.

Capital.—Originally Rbl. 1,200,000 in 12,000 shares of 100 Roubles each. Capital increased to Rbl. 1,800,000 in November, 1911, in order to enable the Company to acquire a licence from Marconi's Wireless Telegraph Company, Limited. Financial year ends December 31st in each year. No dividends have yet been paid.

Rights.—The Company owns the Russian patents taken out in the name of S. M. Eisenstein, and also holds an exclusive licence to use and exploit the Marconi Company's patents in Russia (excluding stations for international communication or on vessels of Russian Mercantile Marine).

The Company has supplied the Russian Government with a large number of Wireless Telegraph stations, and has now a very large amount of work in hand for that Government.

Compañia Marconi de Telegrafia Sin Hilos Del Rio de la Plata

Incorporated.—August 4th, 1906.

Head Office.—Tornquist Building, 132, San Martin, Buenos Aires, Argentine.

Directors.—Commendatore G. Marconi, Captain Guillermo José Nunes, Enrique Schlieper, Antonio Terrarosa, Sydney St. J. Steadman, Colonel Sir Thomas Holdich, K.C.M.G., K.C.I.E., C.B., Godfrey C. Isaacs, Senor J. A. Pilling, Senor Don Florence O'Driscoll.

Secretary.—Enrique Schlieper.

Capital.—$2,000,000 gold, represented by 250,000 shares of $5 gold each, series "A.A.," fully paid, and 150,000 Preference shares of 5 per cent. non-cumulative of $5 gold each, series "B.B." 35 per cent. has been called up on the "B.B." shares. The balance is payable in instalments of 10 per cent. with not less than 30 days' notice. The financial year of the Company ends at May 31st in each year. No dividends have yet been paid. The Company owns the Marconi patents and patent rights for the Argentine Republic, and has licences from Marconi's Wireless Telegraph Company, Ltd., and the Marconi International Marine Communication Company, Ltd., to work the Marconi system in the Republics of Argentine, Uruguay, and Paraguay. The Company has the permission of the Government to erect Wireless Telegraph stations within the territorial limits of the Argentine Republic and on vessels flying the Argentine flag. The Company is preparing to erect a high-power Wireless Telegraph station in the Argentine Republic to communicate direct with a similar station in Europe, and the Argentine Government approved this project on August 10th, 1912.

The Marconi Press Agency, Limited

(Private Company).

Incorporated.—October 7th, 1910.

Head Office.—Marconi House, Strand, London, W.C.

Directors.—Commendatore G. Marconi, Godfrey C. Isaacs, Major S. Flood-Page, Alfonso Marconi, Captain H. Riall Sankey.

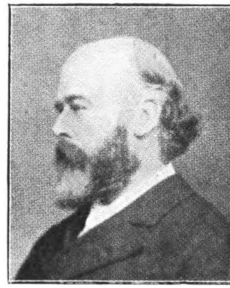
Secretary.—Henry W. Allen, F.C.I.S.

Capital.—£1,000 in 1,000 shares of £1 each.

The Company was formed to act as Advertising Agents, Publishers, and as a News Distributing Agency.

Sir Wm. Preece

Prof. Righi

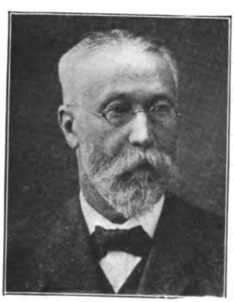


Sir Oliver Lodge

Count Von Arco

G. C. Isaacs

Dr. J. A. Fleming



F. Braun

A. Blondel

Max Wein

[*To face page* 524

BIOGRAPHICAL NOTICES

ARCO, GRAF, GEORG VON.—Born at Grossgorschütz, Germany. Educated at Berlin University and the Technical High School, Charlottenburg. In 1898 he was appointed assistant to Professor Slaby in the department of Wireless Telegraphy; later he joined the Allgemeine Elektrizitäts Gesellschaft, Berlin, and in 1903 was appointed manager of Gesellschaft für Drahtlose Telegraphie. He is also a director of the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie.

AUSTIN, LOUIS WINSLOW, Ph.D.—Was for a time assistant professor of physics at the University of Wisconsin, and later on the staff of Physikalisch-Technische Reichsanstalt at Berlin. It was at this time that he became seriously interested in Wireless Telegraphy, and on his return to America in 1904 he followed up his work begun at Berlin on high temperatures and the discharge of electricity through gases. His early work was specially connected with detectors. One of the most important investigations undertaken by him has been in connection with the development of a method of quantitative measurement of electrical oscillations in the recent antenna. He was recently sent on a mission to study wireless conditions in Europe, and in June, 1912, represented the United States at the International Radiotelegraphic Congress in London. He is at present chief of the United States Radiotelegraphic Laboratory in Washington.

BAKER, T. THORNE.—Born March 19th, 1881. Educated at Mercers' School, London, and passed Intermediate Science examination at the University of London. After five years' work as research chemist he went to Paris in 1907 for the *Daily Mirror* to take up Prof. Korn's system of photo-telegraphy, and superintended the operation of the system between Manchester, Paris, and London. Mr. Baker has since associated himself with work in Wireless Telegraphy and Telephony.

BANTI, PROF. ANGELO.—Born in Orbetello, Grosseto, Italy, in 1859. After a course of scientific study in Paris he entered the Rome University, where he took the degree of Doctor in Physics. He practises as a consulting electrical engineer and expert, and acts as scientific adviser to many electrical companies, municipalities, etc. In 1902 he issued various

publications on Wireless Telegraphy; in 1903 he published an article relating to his investigations on the singing arc.

BEGGEROW, DR. HANS.—Born September 30th, 1874. Educated at the University of Berlin and Freisburg-breisgan, where he obtained his Doctorate. Since 1901 he has been in the German Admiralty as expert in all matters concerning wireless telegraphy, and since 1906 he has occupied a similar position in the Prussian Army.

BELLINI, DR. ETTORE.—Born at Foligno, Italy, on April 13th, 1876, and educated at Naples University. In 1901 he was appointed Electrical Engineer to the Royal Italian Navy, and in 1906 he became chief of the naval Electrical Laboratory at Venice, in which latter capacity he was responsible for carrying out research work dealing with the employment of Wireless Telegraphy on warships and submarines. Later, in conjunction with Capt. Tosi, he invented the Radiogoniometer, an apparatus for directive Wireless Telegraphy. In 1910 the Bellini-Tosi system was installed at the Boulogne-sur-Mer station of the French Post Office, and in 1912 Dr. Bellini joined the staff of Marconi's Wireless Telegraph Company, Ltd., which acquired the patent rights for the construction and commercial development of the wireless compass.

BLONDEL, ANDRÉ E.—Born in Chaumont, France, in 1863, and graduated at the Paris University. He has taken part in notable movements in lighting methods and apparatus, and has been a frequent contributor to learned societies and technical journals on several subjects, including Wireless Telegraphy, in connection with which he invented a new apparatus which opened a fresh field for the study of alternate currents.

BRANLY, EDOUARD.—Born at Amiens on October 23rd, 1844. He studied at the St. Quentin College, afterwards at Henry IV. College, Paris. He is a Fellow of the University, Doctor of Physical Science, and Doctor of Medicine. Some of his works relate to the electrical conductivity of radio-conductors, and in 1900 the International Jury of Superior Precept Instruction awarded him a *grand prix* for his exhibition of radio-conductors, and the French Minister of Public Instruction made him a "Chevalier of the Legion of Honour" in recognition of the part he has played in connection with the discovery of "Wireless Telegraphy." He has constructed

Major S. Flood-Page

W. Duddell, F.R.S.

Dr. Hans Beggerow

M. Travailleur

Commander F. G. Loring

Mr. S. Geoghegan

Dr. L. Mandelstam

[*To face page* 526

various independent distributing apparatus for producing tele-mechanical effects without wires. In January, 1911, he was elected a member of the Academy of Science, Paris.

BRAUN, PROF. FERDINAND.—Born at Fulda on June 6th, 1850, and studied at Marbourg and Berlin. He has held several academic appointments, and in recent years has devoted his attention to Wireless Telegraphy. In December, 1910, he received (with Mr. Marconi) the Nobel Prize for Physics.

BROWN, SYDNEY GEORGE.—Born in 1873 in Chicago, U.S.A., and brought to England at an early age. He received his education at Harrogate and University, London. He took up the study of submarine telegraphy, and among his important inventions is the well-known drum cable relay and the magnetic shunt. He has also devoted attention to Wireless Telegraphy.

BURSTYN, DR. W.—Born in Austria in 1877, and educated at the University of Vienna. He started his career as an electrical engineer with the Siemens-Schuckert Werke at Charlottenburg, and with the Gesellschaft für Drahtlose Telegraphie.

CABLE, BENJAMIN STICKNEY.—Born at Roch Island, Illinois, on September 24th, 1872. He graduated B.A. at Yale University in 1895, and LL.B. at Columbia University Law School in 1898. After two years of private practice, he entered the Law Department of the Chicago, Roch Island & Pacific Railway, and rose from the station of Law Clerk to that of General Attorney. He was recently appointed Assistant Secretary at Department of Commerce and Labour, and is responsible for administration of the United States Wireless Laws affecting shipping.

CHARLTON, CAPTAIN E. F. B.—Is Assistant Director of Torpedoes at the Admiralty, which position carries with it the responsibilities in all matters connected with the design, working, and development of wireless telegraphy at the Admiralty.

CROOKES, SIR WILLIAM, O.M., F.R.S.—Born in London June 17th, 1832, and in 1854 was appointed superintendent of the Meteorological department of the Radcliff Observatory, Oxford. He has carried out a long series of original investigations, and has also published some interesting articles on Wireless Telegraphy.

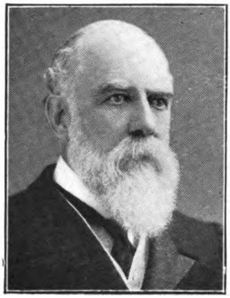
DE FOREST, DR. LEE.—Born in the United States of America, and graduated at Yale College. He has been identified with Wireless Telegraphy since 1896.

DUBILIER, WILLIAM.—Born at Seattle, U.S.A., on July 25th, 1888. In 1904 he made one of the first amateur Wireless Telegraph apparatus in the United States, and he has since devoted himself to Wireless Telegraphy and electricity. During recent years he has mainly occupied himself with experiments in Wireless Telephony.

DUDDELL, W., F.R.S.—Born in London in 1872 and educated privately in this country and in France. He carried out research work at the Central Technical College, London, between 1893 and 1900. In 1908 he read, in conjunction with Dr. E. W. Marchant, a paper on "Experiments on Alternate Current Arcs by the Aid of Oscillographs" before the Institution of Electrical Engineers, and in 1900 he read a paper on "Rapid Variations of Current through the Direct Current Arc." He received a gold medal for oscillographs at the Paris Exhibition of 1900, and at St. Louis in 1904. He is President of the Institution of Electrical Engineers for 1912-1913. He is also a member of the technical committee appointed by the Government in 1912 to consider the question of long-distance wireless telegraphy.

ECCLES, W. H., D.Sc., A.R.C.S.—Born in Furness, Lancs., in 1875, and entered the Royal College of Science, South Kensington, in 1894. Three years later he was appointed demonstrator in the Physics Laboratory at the College, and in 1898 he graduated at the London University with first-class honours in Physics. In 1899 he entered Mr. Marconi's laboratory at Chelmsford and spent a great part of his time in the investigation of electrical oscillations of air wires and in "jiggers." He also devised a laboratory method for testing and classifying coherers, and results of a later study of coherers were presented as his D.Sc. thesis. In 1901 Dr. Eccles was appointed head of the department of mathematics and physics at the South Western Polytechnic, Chelsea, and he is now University Reader in Graphics at University, London. He is a member of the Council of the Physical Society and examiner in mathematics at the London University, and secretary of the British Association Committee on Radio-telegraphic Investigations.

EICHHORN, GUSTAV, PH.D.—Born at Düsseldorf (Germany) on December 1st, 1867. After leaving the Realgymnasium he took up the study of physics, but this was interrupted by the death of his father, whose paper mills he then entered. For ten



Mr. H. S. Saunders

Capt. H. R. Sankey

Col. A. Thys

B. Koehler

Delegate (Germany) London
Radiotelegraphic Conference
1912

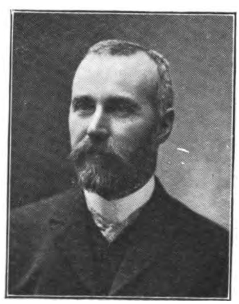
Prof. A. Battelli

Delegate (Italy) London
Radiotelegraphic Conference
1912

J. Banneux

Delegate (Belgium) London
Radiotelegraphic Conference
1912

Mr. B. S. Cable



Mr. D. Robertson

Secretary, General Post
Office, Wellington.

Alfonso Marconi

[*To face page* 528

years he devoted himself to a business career; then he returned to the profession of his choice and continued his interrupted studies. After three years at Berlin, Munich, and Zürich, he took the degree in physics (Phil. Dr.) at the last-named University. He was about to enter upon an academical career when unforeseen circumstances again intervened and he was compelled to follow practical pursuits. He entered a wireless telegraph laboratory, and soon after he was appointed manager of experimental stations on the Baltic, where, for about eighteen months he conducted a number of investigations. The results of these are incorporated in a book which was published in England and Germany. He has contributed to various technical journals and has invented a device which is used in connection with wave meters and other instruments. He returned to Zürich in 1905 and introduced wireless telegraphy to the Swiss Military Authorities. Two years later he launched the *Jahrbuch de drahtlosen Telegraphie und Telephonie,* which is now a well-known publication. He is still engaged in practical and theoretical work in wireless telegraphy and telephony.

ERSKINE-MURRAY, DR. JAMES.—Born in Edinburgh on October 24th, 1868, and after a course of six years' study under the late Lord Kelvin at Glasgow University he entered Trinity College, Cambridge, as a research student. In 1898 he was appointed experimental assistant to Mr. Marconi. In 1900 he took up the post of lecturer and demonstrator in physics and electrical engineering at the University College, Nottingham, and in 1905 he was appointed to the lectureship in electrical engineering at the George Coates' Technical College, Paisley. In 1905 he took up consulting work in radiotelegraphy, and he now holds the lectureship in radiotelegraphy at the Northampton Institute.

FERRIÉ, COMMANDANT.—He is attached to the department of the Ministry for War, France, and is in charge of the installation at the Eiffel Tower, Paris.

FESSENDEN, REGINALD AUBREY.—Born at Milton, Canada, on October 6th, 1866. Educated at New York and Port Hope, Ontario. In 1886 he was appointed inspecting engineer to the Edison Company, N.Y. In 1892 he took up teaching work and conducted classes in physics and electrical engineering at Western University, and in 1893 he was appointed Professor of Electrical Engineering at Western University of Phila-

delphia. He has associated himself with the development of Wireless Telegraphy and Wireless Telephony.

FLEMING, DR. JOHN AMBROSE, F.R.S.—Born in Lancaster on November 29th, 1849. Educated at University College School, London; University College; the Royal School of Mines; and St. John's College, Cambridge; Hughes Gold Medallist of the Royal Society. He was appointed demonstrator in mechanics and applied science to the University of Cambridge, and when University College, Nottingham, was opened in 1881 Dr. Fleming was selected as first occupant of the chair of mathematics and physics. He resigned this professorship shortly afterwards to remove to London. In 1885 the Council of the University College, London, created a chair of electrical engineering, and they appointed Dr. Fleming as the first occupant of that chair. Later the bulk of the funds subscribed towards the Sir John Pender memorial was employed to endow the chair of electrical engineering at University College and for the maintenance of the electrical laboratory, subject to the condition that the laboratory should henceforth be known as the Pender Laboratory, and the chair occupied by Dr. Fleming as the Pender Chair of Electrical Engineering. After the incorporation of the University College with the University of London the title of Dr. Fleming's chair was changed to that of Pender Professor in the University of London. In 1912 Dr. Fleming was appointed University Professor of Electrical Engineering in the University of London. He is the author of numerous well-known text-books, amongst which may be mentioned particularly his books on Wireless Telegraphy. He has given many courses of lectures at the Royal Society of Arts and the Royal Institution on Wireless Telegraphy and kindred subjects.

FLOOD-PAGE, MAJOR SAMUEL.—He has served in military campaigns in India, and besides active service he was occupied with administrative work. On retiring from the Army he devoted himself to business, and one of his achievements which may be mentioned is the introduction of the first incandescent electric lamps into Australia. He joined Marconi's Wireless Co., Ltd., in 1899, as managing director, and still remains a director of the company. Many movements—national, commercial and philanthropic—have found in him an earnest supporter.

Dr. J. Zenneck

Baron Von Teufenstein

Delegate (Austria) London Radiotelegraphic Conference, 1912

Dr. G. Eichhorn

A. M. da Silva

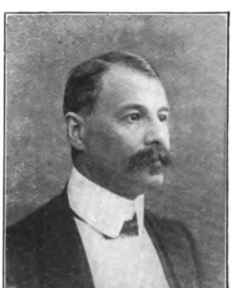
Delegate (Portugal) London Radiotelegraphic Conference, 1912

H. J. Nierstrass

Delegate (Holland) London Radiotelegraphic Conference, 1912

A. Frouin

Delegate (France) London Radiotelegraphic Conference, 1912



G. J. C. A. Pop

Delegate (Holland) London Radiotelegraphic Conference, 1912

F. Wagner Von Jauregg

Delegate (Austria) London Radiotelegraphic Conference 1912

G. M. de Bloeme

Delegate (Holland) London Radiotelegraphic Conference, 1912

[*To face page* 530

FROUIN, M.—He is Director of the French Telegraphs and was one of his country's representatives at the International Radiotelegraphic Conference held in London in 1912.

GEOGHEGAN, SAMUEL.—Apprenticed to a firm of mechanical engineers in Birmingham, he has had considerable experience in railway and bridge work in England and various parts of the world. In 1875 he was appointed Chief Mechanical Engineer to Messrs. Arthur Guinness & Co., of Dublin, in whose service he spent 30 years. While with that firm he laid out a system of tram lines in which there was a spiral incline of 120 feet diameter for 2½ turns and a gradient 1 in 40. He is a member of the Institution of Mechanical Engineers, the Midland Institution of Mining, Civil and Mechanical Engineers, the Institution of Civil Engineers of Ireland, and a member of the Council of the Royal Dublin Society.

GLAZEBROOK, DR. R. T., F.R.S.—Born at Liverpool, September 18th, 1854. Educated at Trinity College, Cambridge, where, after taking his degree, he commenced a study of physics at the Cavendish Laboratories under Clerk Maxwell. In 1899 he was appointed by the Royal Society as the first director of the National Physical Laboratory, which position he still holds. He is a member of the technical committee enquiring into the Imperial Wireless Scheme.

HOWE, PROF. GEORGE WILLIAM OSBORN.—Born December 4th, 1875, at Charlton, Kent. Educated at Roan School, Greenwich, and at Woolwich Polytechnic. After some industrial experience he joined the teaching staff of the City and Guilds Engineering College, and was later appointed Assistant Professor of Electrical Engineering at the College. He has read several papers on radiotelegraphy before the British Association and the Physical Society, and in 1912 he was awarded the silver medal by the Royal Society of Arts for his paper on "Some Recent Developments in Wireless Telegraphy."

ISAACS, GODFREY C.—Educated in England, France and Germany. He began life in his father's business and at 18 years of age he was manager of the great concern which he had entered as a lad. Young as he was, he not only mastered all the difficult questions connected with the foreign trade, with which his father was chiefly concerned, but as manager he was able to carry on the important correspondence of the business of the firm in the various languages of the leading

customers. Added to this, and while at an early age, he, in the course of his extensive travels in all parts of Europe, exhibited great ability in dealing with leading business men of nearly all nationalities. In 1910 he was appointed Managing Director of Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Marine Communication Co., Ltd.

KENNEDY, SIR A. W. B., F.R.S.—Born in London, March 17th, 1847. He has had great mechanical engineering experience and has been President of the Institution of Civil Engineers and the Institution of Mechanical Engineers. He has designed electric lighting and power stations for many Corporations, and has also been engaged in traction work. He received the honour of knighthood in 1905 on account of his services to the Admiralty. He is a member of the technical committee considering the Imperial Wireless scheme.

KORN, PROFESSOR ARTHUR.—Born at Breslau, Germany, 1870. He is best known as the inventor of a system of telegraphic transmission of photographs, and has published various books on this subject.

LODGE, SIR OLIVER, F.R.S.—Born at Penkhall, Staffs., on June 12th, 1851. He was educated at the Newport (Salop) Grammar School, and was intended for a business career, but being attracted to science he entered University College, London, in 1872, and graduated D.Sc. five years later. He was reader in natural philosophy at Bedford College for Women, then Professor of Physics in University College, Liverpool, before being appointed, in 1900, the first Principal of the new Birmingham University. He was knighted in 1902. He has distinguished himself in various spheres of thought, and his original work includes investigations on lightning, the seat of the electromotive force in the voltaic cell, the phenomena of electrolysis and the speed of the ion, the motion of the ether near the earth, and electromagnetic waves and wireless telegraphy. His patent for syntonic wireless telegraphy has been acquired by the Marconi Co. He presided over the mathematical and physical section of the British Association in 1891 and is President-Elect of the British Association for the ensuing year. He has also served as President of the Physical Society and the Society for Psychical Research. He has made many important contributions to the literature of science and has written various books and papers of a metaphysical and theological character.

C. P. Edwards
Delegate (Canada) London Radiotelegraphic
Conference, 1912

C. J. Desbarats
Delegate (Canada) London Radiotelegraphic
Conference, 1912

C. McK. Saltzman
Delegate (U.S.A.) London
Radiotelegraphic
Conference, 1912

Willis L. Moore
Delegate (U.S.A.) London
Radiotelegraphic
Conference, 1912

A. G. Webster
Delegate (U.S.A.) London
Radiotelegraphic
Conference, 1912

Dr. W. Austin
Delegate (U.S.A.) London Radiotelegraphic
Conference, 1912

Major G. O. Squier
Delegate (U.S.A.) London Radiotelegraphic
Conference, 1912

LORING, COMMANDER F. G.—Is a Captain in the British Navy and is Inspector of Radio-telegraphy to the Post Office.

MADGE, HENRY ASHLEY, B.A., A.M.I.E.E.—Born February, 1879. Educated at Peterhouse, Cambridge (1898-1902), where he took honours in Mathematics and Mechanical Science (Engineering). July, 1902, to September, 1903, Junior Engineer with Marconi's Wireless Telegraph Co., Ltd.; October, 1903, to January, 1904, Royal Naval College, Greenwich; February, 1904, to March, 1905, Naval Instructor in H.M.S. *Vernon;* April, 1905, Expert in Wireless Telegraphy in H.M.S. *Vernon.*

MANDELSTAN, LEONID.—Born May 5th, 1879, in Mogilew, Russia, he studied mathematics and physics at the University of Strassburg under Professor Braun, and in 1902 he was appointed Dr. r.e.r. of Physics at that University.

MARCONI, ALFONSO.—Born at Bologna in 1865, he is about eight years older than his distinguished brother. He was educated at the Bedford Grammar School in England and later at Technical Colleges in Florence and Leghorn. He joined the board of Marconi's Wireless Telegraph Company and the Marconi International Marine Communication Co., Ltd., in July, 1909.

MARCONI, COMMENDATORE GUGLIELMO, LL.D., D.Sc.—Born at Bologna, in Italy, on April 25th, 1874, he is Irish on his mother's side. He was educated at Leghorn and Bologna University, and first began to interest himself in the problem of Wireless Telegraphy in 1895. In the following year he came to England, and took out the first patent ever granted for a practical system of Wireless Telegraphy by the use of electric waves. His first experiments in England were made at Westbourne Park. Shortly afterwards Mr. Marconi saw Sir W. H. Preece, and at his request made some experiments for him and the Post Office officials, between the Post Office and the Thames Embankment. These experiments were highly successful, and Mr. Marconi was requested to make further trials on Salisbury Plain, which also proved satisfactory to the Post Office and to officers of the Army and Navy who witnessed them. Mr. Preece, in December, 1896, delivered a lecture at Toynbee Hall on the subject of "Telegraphy Without Wires," and Mr. Marconi was present and conducted the experiments. Some further experiments were

made in May, 1897, in the Bristol Channel, when Lavernock and Flatholm were successfully connected, and afterwards Lavernock and Brean Down, across the Channel, a distance of nine miles. A full report of Mr. Preece's lecture, in which these experiments were dealt with, was given before the Royal Institution on June 4th, 1897. On the invitation of the Italian Government, Mr. Marconi went to Rome and gave a series of exhibitions of the Marconi system at the Quirinal before the King and Queen of Italy and high Italian Government officials, and he subsequently went to Spezia, where his system was put to practical test on board two Italian battleships. A station was erected on land at the arsenal, and the ships were kept in constant telegraphic communication with the shore up to 12 miles from the spot where the apparatus was fixed. The Italian Government, recognising the great value of Mr. Marconi's invention, conferred upon him the honour of knighthood, and are now using his system extensively. On his subsequent return to England Mr. Marconi conducted further experiments at Salisbury (between Salisbury and Bath, a distance of thirty-four miles), and signals were successfully received by Captain Kennedy, who himself erected a set of Marconi instruments at Bath for this installation. On July 20th, 1897, the Wireless Telegraph and Signal Co. Ltd.—now known as Marconi's Wireless Telegraph Co., Ltd.—was established, and two permanent stations were put up—the first at Alum Bay, Isle of Wight. A small steamer was chartered in connection with the experiment here carried out, and fitted with the necessary instruments, the steamer cruising round the coast about Christmas time for several weeks. Although tempestuous weather was experienced no break in telegraphic communication with the station took place. At the beginning of 1898 another permanent land station was put up at Bournemouth and subsequently removed to Poole. The first station was 14½ miles distant across the sea, and the removal to Poole increased this distance to 18 miles. By the aid of these stations great progress was made in developing Wireless Telegraphy. In May, 1898, an exhibition of Wireless Telegraph apparatus was made in the House of Commons and at St. Thomas's Hospital. A number of social and other messages had been sent over the Wireless Telegraph Co.'s service under various conditions and in several languages, and these messages had been transmitted without mutilation to their destination. In July, 1898,

the Dublin *Express* gave day by day a Wireless Telegraphic report of the yacht races during Kingstown Regatta week, and proved the usefulness and facility with which the system can be applied to commercial purposes. Later Mr. Marconi established communication between the late Queen's residence at Osborne House, Isle of Wight, and the Royal yacht *Osborne,* and Her late Majesty was kept apprised of the progress made by the King during the process of recovery from a serious accident. No difficulty has been experienced in transmitting or receiving messages from the established land stations, and in the week ending December 24th, 1898, Mr. Marconi was engaged in installing apparatus to provide communication between a lighthouse and a lightship on the South Coast, the Trinity House authorities having placed a room at the South Foreland lighthouse at Mr. Marconi's disposal for the purpose. Mr. Marconi is a member of the Institution of Electrical Engineers, and read a paper on "Wireless Telegraphy" before the members in February, and lectured at the School of Military Engineering, Chatham, in March, 1899. He journeyed to the United States in connection with the America Cup Yacht racing for 1899, between *Columbia* and *Shamrock I.* In the same year a number of the ships of the British Navy were equipped with Marconi apparatus. Early in 1901 telegraphic communication was established between two points more than 250 miles distant, and at the end of that year Mr. Marconi transmitted signals from Poldhu, in Cornwall, to St. John's, Newfoundland. Marconi apparatus is working commercially on board most of the largest passenger steamers afloat, including the ships of the famous shipping lines in England, France, Germany, Italy, America, Canada, etc. A demonstration of the Marconi system was made for the French Government in the early part of 1901, when communication was established and maintained for some time between Antibes, near Nice, and Calvi, Corsica. At the same time the yacht of the Prince of Monaco was fitted with Marconi apparatus. The international yacht races were reported for the American Associated Press by the Marconi system. An important agreement was made during 1901 between the Marconi International Marine Communication Co. and Lloyd's, by which the latter corporation adopts exclusively the Marconi system, and agrees to fit up its stations with Marconi apparatus. Mr. Marconi's system is the only means of telegraphic communication throughout the

Sandwich Islands, the islands in this group having been fitted with the apparatus during 1901. In February, 1902, Mr. Marconi received on board the s.s. *Philadelphia,* in the presence of the officers, good messages on the tape when at a distance of over 1,500 miles from the transmitting station, and signals at over 2,000 miles. In December, 1902, the station established at Cape Breton, Nova Scotia, under a contract with the Canadian Government, for transatlantic Wireless Telegraphy, was put into communication with the Cornwall station at Poldhu, and inaugural messages were transmitted to H.M. the King of England, H.M. the King of Italy, and others, and to *The Times* newspaper, this message for purposes of verification being transmitted in the presence of *The Times* correspondent at Cape Breton, and of the officers of the Italian warship *Carlo Alberto.* In October, 1903, during the voyage of the R.M.S. *Lucania,* Mr. Marconi established communication between this ship and the Marconi stations at Glace Bay, Canada, and Poldhu, Cornwall, England; communication was continued throughout the voyage, messages received, and a bulletin published and issued daily to each passenger. At the end of October, 1903, Mr. Marconi, at the invitation of the British Admiralty, sailed on board H.M.S. *Duncan* from Portsmouth to Gibraltar, and throughout the voyage messages were received on board from the Marconi station at Poldhu. Communication was also carried on between the Marconi station on the Rock of Gibraltar and that at Poldhu. In February, 1904, Marconi Wireless Telegraph stations were opened at Broomfield, in Essex, England, and at Amsterdam, in Holland, for the transmission between the two countries of Press messages and Stock Exchange quotations, these messages being transmitted in Dutch by English operators, having no knowledge of that language, at a speed of from 25 to 30 words per minute, and afterwards published in a leading Dutch newspaper, the *Handelsblad.* On June 4th, 1904, a daily service of wireless news messages all the way across the Atlantic was inaugurated on board the Cunard R.M.S. *Lucania,* and a newspaper, entitled *The Cunard Daily Bulletin,* is now regularly published on this vessel, as well as on all the important vessels belonging to this line. Similar journals are published on the ships of the American Line, on the *New Amsterdam* (Holland-American), and on others. On August, 3rd, 1904, Marconi Wireless Telegraph stations were opened at Bari,

Commander E. F. B. Charlton
Delegate (British Admiralty)
London Radiotelegraphic
Conference, 1912

Capt. W. R. W. Kettlewell
Delegate (British Admiralty)
London Radiotelegraphic
Conference, 1912

Lieut. J. A. Slee
Delegate (British Admiralty)
London Radiotelegraphic
Conference, 1912

Mr. F. W. Home
Delegate (British Post Office)
London Radiotelegraphic
Conference, 1912

Mr. J. E. Taylor
Delegate (British Post Office)
London Radiotelegraphic
Conference, 1912

Col. G. W. M. MacDonogh
Delegate (British War Office)
London Radiotelegraphic
Conference, 1912

Mr. R. J. Mackay
Delegate (British Post Office)
London Radiotelegraphic
Conference, 1912

Mr. J. Louden
Delegate (British Post Office)
London Radiotelegraphic
Conference, 1912

Mr. A. W. Cross
Delegate (British Post Office)
London Radiotelegraphic
Conference, 1912

[*To face page* 536

in Italy, and Antivari, in Montenegro, for the purpose of carrying on a public telegraph service between Italy and the Balkan States. The Messina Railways have adopted the Marconi system for intercommunication between their stations. During 1905 a contract was entered into with the Board of Trade for the establishment of Marconi Wireless Telegraphy on the lighthouses and lightships round the coast of the United Kingdom. Practically the whole of the ships belonging to the British and Italian navies have been equipped with Marconi Wireless Telegraphy, and the system is now extensively used by those two countries. During 1905 many more additional stations were erected to the order of the Canadian and Newfoundland Governments, and at the present time all the important points about the Gulf of St. Lawrence are linked together by a chain of short-range wireless stations. A powerful station at Clifden, on the West Coast of Ireland, was opened early in 1907, by means of which communication with the American Continent (Glace Bay) has been established, and daily service was maintained until a fire occurred at Glace Bay station on August 21st, 1909. 1908 and 1909 were periods of great activity with Mr. Marconi. Owing to the fire at Glace Bay the service between that station and Clifden had been suspended, but the work of restoring the installation of new plant, which was superintended by Mr. Marconi, was completed on the 23rd April, 1910, and since that date the service has been working satisfactorily, the messages being distributed thence to all parts of the European and American continents. Mr. Marconi's work has been recognised by many governments and seats of learning; he has been decorated by the King of Italy and the Czar of Russia, is an honorary doctor of many universities, including Oxford, Glasgow, Aberdeen, Liverpool, and Pennsylvania, besides having received the freedom of the principal Italian cities. In 1909 he was accorded what is perhaps the highest distinction that can be obtained by any scientist—the Nobel Prize for Physics.

PREECE, LLEWELLYN.—Son of Sir William H. Preece. In 1889 he combined with his father, his brother Arthur Henry Preece, and the late Major Phillip Cardew as consulting engineers. He is now one of the principal partners in the firm of Preece, Cardew & Snell, Consulting Engineers to the Crown Agents to the Colonies, and to the High Commissioners of New Zealand and South Africa. During the last thirteen years

he has been largely responsible for the wireless telegraph work in connection with the Crown Colonies, which has been placed in the hands of his firm.

PREECE, SIR WILLIAM H., F.R.S.—Born in 1834 near Carnarvon. An electrical and telegraph engineer of great eminence, who was appointed Engineer-in-Chief and Electrician to the Post Office in 1892, and Consulting Engineer to the Post Office in 1899, from which he retired in 1904. He is a Past-President of the Institute of Civil Engineers, and was President of the Society of Telegraph Engineers, first in 1880, and again in 1893. The latter Society is now called The Institution of Electrical Engineers. He has various inventions relating to telegraphy to his credit, and is one of the pioneers of wireless telegraphy.

RAYLEIGH, THE RT. HON. LORD.—Born on November 12th, 1842. Educated at Torquay and at Trinity College, Cambridge. In 1865 he graduated in the Mathematical Tripos as Senior Wrangler, and was awarded the first "Smith's Prize." His work in Physics has been of a varied and thorough character. He has contributed to the Royal Society some important communications on the "Propagation of Electrical Waves Round the Bend of the Earth."

RIGHI, PROFESSOR AUGOSTO.—Born at Bologna in 1850, and educated at the University there. He was Professor of Physics from 1873 to 1880 at the Bologna Technical Institute; 1880 to 1885 at the Palermo University; from 1885 to 1889 at the Padua University; and since 1890 at the Bologna University. Mr. Marconi is one of the most eminent of this distinguished Professor's old students. Professor Righi has published many important papers on physics, among which may be mentioned "Hertzian Waves," in 1900; "Telegraphy Without Wires" (in colloboration with B. Dasseau), in 1902, etc.

SANKEY, CAPTAIN M. H. P. RIALL.—Born at Nenagh in Ireland in 1853 and educated in Switzerland and at the Royal Military Academy, Woolwich, and the School of Military Engineering, Chatham. He had a distinguished career in the Royal Engineers before retiring to devote himself entirely to engineering work. He is a director of Marconi's Wireless Telegraph Co., Ltd.

SALTZMAN, MAJOR C. MCK.—He is a native of the State of Iowa, and graduated at the United States Military Academy at West Point in 1896. As a Cavalry officer he participated in

the battles near Santiago de Cuba of the Spanish-American War of 1898, and later as a Signal Officer participated in the Philippine Insurrection in the Philippine Islands. In 1901 he was transferred to the Signal Corps of the U.S. Army, and has since been identified with the electrical, cable and radio work of the U.S. Army. Major Saltzman for several years has been in charge of the Electrical Laboratory of the Signal Corps in Washington, where radio equipment of the U.S. Army is designed and tested. He represented the United States at the International Radiotelegraphic Conference in London in June, 1912.

SAUNDERS, HENRY SPEARMAN.—Born April, 1841, he is the son of the Hon. Frederick Saunders, who was Treasurer of Ceylon, to which office the latter was succeeded by his eldest son, Sir Frederick Richard Saunders, K.C.M.G. Mr. Henry S. Saunders joined his parents in Ceylon at the age of 18, and he devoted himself with conspicuous ability and success to the public and commercial life of the colony. He was for two years Chairman of the Planters' Association. He was also instrumental in carrying through important schemes of railway extension and the construction of roads, and his services in the latter respect gained for him the appreciation of the Director of Public Works. On returning to England about thirteen years ago Mr. Saunders joined the board of Marconi's Wireless Telegraph Co. He accompanied Mr. Marconi to America on board the ss. *Philadelphia* in 1902, and he was one of the first directors of the Marconi International Marine Communication Co., Ltd.

SWINBURNE, JAMES, F.R.S.—Born at Inverness on February 28th, 1858, and educated at Clifton College. He has had a wide experience, and as far back as 1881 he was employed by Messrs. J. W. Swan & Co. to organise their lamp factory in Paris; later he went on a similar mission to America. He has practised as a consulting engineer since 1894, and has attained considerable eminence in various branches of science. As an expert on wireless telegraphy his fame has been recognised by the Government, who in 1912 appointed him a member of the Technical Committee considering the Imperial Wireless Scheme. He is also a member of various scientific societies, and is on the Council of some. In 1902-3 he was President of the Institution of Electrical Engineers.

SWINTON, ALAN A. CAMPBELL.—Born in 1863, he commenced his career in 1882 in the famous Elswick Works of Armstrong,

Whitworth & Co., and two years later succeeded to the position of Electrical Engineer to the Company. He has devoted considerable attention to scientific research, including wireless telegraphy.

THYS, COLONEL ALBERT.—He has been intimately associated with wireless telegraphy ever since its inception as a commercial possibility, and is a director of Marconi's Wireless Telegraph Co., Ltd., La Compagnie de Télégraphie Sans Fil and the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie m.b.H.

TRAVAILLEUR, MAURICE.—Born at Brussels in 1871 and graduated as engineer at Brussels University in 1893. At the age of 26 he was appointed electrical engineer to the late King of the Belgians. He was one of the founders of La Compagnie de Télégraphie Sans Fil in 1901, of which he is now managing director, besides being on the Boards of Marconi's Wireless Telegraph Co., Ltd., and the Deutsche Betriebs Gesellschaft für Drahtlose Telegraphie, and other companies.

WEIN, PROFESSOR MAX.—Born at Königsberg in 1866. He made a special study of the subject of physics under Helmholtz and others and assisted Rontgen from 1891 to 1893. He is at present at the University of Jena and has devoted considerable attention to the study of electromagnetic waves and their propagation.

ZENNECK, PROFESSOR J.—Born April 15th, 1871, in Wurtemburg. The son of a clergyman, he was intended for a similar career, and studied for four years in a Theological College at Tübingen. While at Tübingen he studied mathematics and natural history, particularly zoology, from 1889 to 1894, and in the latter year he passed the State examination in these subjects; he obtained his doctorate in 1894. After a course of natural history studies in London and elsewhere he devoted himself entirely to physics and from 1895 to 1899 he was an assistant in the Physical Institute in Strassburg. In 1899 to 1900 he was engaged in making tests with Wireless Telegraphy in the North Sea. Five years later he became lecturer and assistant professor of Physics in the Technical College, Dantzic, and in 1906 he was appointed professor of Physics at the Technical College, Brunswick. This position he vacated in 1909, when he joined one of the largest mechanical works in Germany, and in 1911 he returned to Dantzic as professor of the Technical College, a position which he still holds with distinction.

T. Heftye
Delegate (Norway)
London Radiotelegraphic Conference,
1912

C. E. Rickard
Delegate (Chili)
London Radiotelegraphic Conference
1912

Réné Corteil
Delegate (Belgium)
London Radiotelegraphic Conference,
1912

Commandant Ferrié
Delegate (France)
London Radiotelegraphic Conference,
1912

Col. D. Sokoltzov
Delegate (Russia)
London Radiotelegraphic Conference
1912

Dr. Bhering
Delegate (Brazil)
London Radiotelegraphic Conference,
1912

[*To face page* 540

LITERATURE OF WIRELESS TELEGRAPHY AND TELEPHONY

THE literature upon the subject of wireless telegraphy and telephony has now become so large that the following collection of representative books and journals should be found useful. The bibliography is by no means complete, but we think that few, if any, of the important works are not included. In addition, there are the reports of the various International Radiotelegraphic Conferences and the "Nomenclature" issued by the Berne Bureau.

THE BOOKS MENTIONED IN THE FOLLOWING PAGES AND OTHERS CAN BE OBTAINED, AT THE PUBLISHED PRICE, FROM THE MARCONI PRESS AGENCY, LTD., MARCONI HOUSE, STRAND, LONDON, W.C., ON RECEIPT OF REMITTANCE AND COST OF POSTAGE.

GREAT BRITAIN.

Studies in Terrestrial Magnetism. By Dr. C. CHREE, F.R.S. 5s. net. MacMillan & Co., Ltd., St. Martin's Street, London, W.C.

Electric Waves. By Professor WM. S. FRANKLIN. Pp. 326. 12s. 6d. net. MacMillan & Co., Ltd.

Electric Waves. By H. HERTZ. Translated by D. E. JONES, B.Sc. Pp. 298. 10s. net. MacMillan & Co., Ltd.

Miscellaneous Papers. By H. HERTZ. Translated by D. E. JONES and G. A. SCHOTT. 10s. net. MacMillan & Co., Ltd.

Modern Theory of Physical Phenomena, Radio-activity, &c. By AUGUSTO RIGHI. Translated by A. TROWBRIDGE. Pp. 180. 5s. net. MacMillan & Co., Ltd.

Modern Views of Electricity. By SIR OLIVER LODGE, F.R.S. Third edition. Pp. 534. 6s. MacMillan & Co., Ltd.

Electromagnetic Theory of Light. Part I. By C. E. CURRY, Ph.D. Pp. 416. 12s. net. MacMillan & Co., Ltd.

The Elements of Electrical Transmission. By O. J. FERGUSON. Pp. 466. 15s. net. MacMillan & Co., Ltd.

The Principles of Electric Wave Telegraphy and Telephony. By DR. J. A. FLEMING, F.R.S. 28s. net. Longmans, Green & Co., London.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Dr. J. A. FLEMING, F.R.S. 7s. 6d. net. Longmans, Green & Co., London.

A History of the Theories of Æther and Electricity (from the Age of Descartes to the Close of the Nineteenth Century). By Dr. E. T. Whittaker, F.R.S. 12s. 6d. net. Longmans, Green & Co.

The Electron Theory (a Popular Introduction to the New Theory of Electricity and Magnetism). By E. E. Fournier, B.Sc., with a preface by Dr. G. Johnstone Stoney, F.R.S. 5s. net. Longmans, Green & Co.

The Radiotelegraphist's Guide and Log Book (a Manual for the use of Operators). By W. H. Marchant. 4s. 6d. net. Whittaker & Co., London.

Wireless Telegraphy and Hertzian Waves. By S. R. Bottone. (1910.) 2s. 6d. net. E. & F. N. Spon, London.

Making Wireless Outfits (an Explanation of the Construc-tion and Use of an Inexpensive Wireless Equipment for Sending and Receiving up to 100 miles). By Newton Harrison. (1909.) 61 pp. 1s. 6d. net. E. & F. N. Spon.

Wireless Telephone Construction. By Newton Harrison. (1909.) 1s. 6d. net. E. & F. N. Spon.

Wireless Telegraphy and Telephony. By Professor D. Mazzotto. Translated by S. R. Bottone. (1906.) 3s. 6d. net. E. & F. N. Spon.

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* Out of print.

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The Electric Telegraph. By EDWIN J. HOUSTON and A. E. KENNELLY. A chapter dealing with "Signalling Without Wires." Pp. 480. Price, 4s. 6d. net. The Hill Publishing Co., Ltd., New York, and 6-8, Bouverie Street, Fleet Street, London, E.C.

Principles of Wireless Telegraphy. By DR. GEO. W. PIERCE. (A book for students and those engaged in operating and constructing wireless telegraph apparatus.) Pp. 350. Price, 12s. 6d. net. The Hill Publishing Co., Ltd., New York and London

Wireless Telegraphy. By A. FREDERICK COLLINS. (History, theory, and practice.) Pp. 300. 12s. 6d. net. The Hill Publishing Co., Ltd.

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La Telegrafía Sin Hilos. By EUGENIO AGACINO and D. RAMON ESTRADA. 8 pesetas. F. Rodríguez de Silva, Cadiz.

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THE WIRELESS WORLD (with which is incorporated the *Marconigraph*). London: Marconi House, Strand, W.C. 3d. monthly. Post free 5s. per annum.

Electrical Review. London. 4d. weekly.

Electrician. London. 6d. weekly.

Electrical Times. London. 2d. weekly.

Electricity. London. 1d. weekly.

Electrical Engineering. London. 1d. weekly.

FRANCE.

La Lumière Électrique. Paris. 1·50 francs weekly.

L' Industrie Électrique. Paris. Weekly.

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Electrotechnische Zeitschrift. Berlin. Weekly. M.20 (per annum).

Jahrbuch der Drahtlosen Telegraphie und Telephonie. Leipzig (and Zürich, Switzerland). Six issues per annum. Price, M.20.

UNITED STATES OF AMERICA.

The Marconigraph. New York: 456, Fourth Avenue, N.Y. City. 10 cents monthly.

Electrical World. New York. 10 cents weekly.

SPAIN.

Telegrafia Sin Hilos. Madrid: Alcala 43. 25 cents monthly.

ITALY.

La Elettricitá. Rome.

RUSSIA.

The Messenger of Wireless Telegraphy. St. Petersburg: Lopouchinskaja 14. Monthly.

LLOYD'S SIGNAL STATIONS.

THE Society of Lloyds has, with the sanction of Parliament, the control and working of signal stations in Great Britain and Ireland and in many places abroad. Various foreign Governments have also recognised the advantage of reports from signal stations and semaphores being universally collected and forwarded on identical conditions. These have arranged that reports from or to their semaphores can be obtained or forwarded through Lloyds.

The charges for forwarding information from or transmitting advices by means of signal stations are moderate. Shipowners, charterers, merchants, or consignees can obtain telegraphic intelligence with regard to any vessel in which they may be interested, or postal advices if so preferred, or can transmit orders to such vessels by communication with Lloyds.

Harbour and dock authorities, Chambers of Commerce, Exchanges, and such institutions that may require a large number of reports, can arrange with Lloyds for receiving full and regular advices from Lloyds' signal stations on moderate terms. When a number of reports are taken a substantial reduction is made in the fees. Shipowners or others who wish to be supplied with reports of vessels from any signal stations are requested to communicate with the Secretary of Lloyds, London, E.C.

An arrangement has been concluded with Marconi's Wireless Telegraph Co. and the Marconi International Marine Communication Company, by which all maritime intelligence received by wireless telegraphy at any station worked by either of these companies, including Poldhu and similar stations primarily used for shore-to-shore or overland telegraphy, shall forthwith be communicated to Lloyds. Masters of vessels equipped with wireless apparatus are accordingly requested to forward to the nearest wireless telegraph station any maritime intelligence—*e.g.*, wrecks, derelicts, casualties, vessels in distress, etc., with a view to its being forthwith communicated to Lloyds. No charge for transmission will be made against vessels for such messages, therefore masters are requested to communicate such intelligence as freely as possible. The following Lloyds' stations in the United Kingdom are fitted with wireless apparatus :—

North Foreland.	Niton.
Fastnet.	Brow Head.
The Lizard.	Rosslare.
Malin Head.	Inishtrahull.

Abroad wireless apparatus has been installed for signalling purposes at—

Suez.	Port Said.

CODE SIGNALS

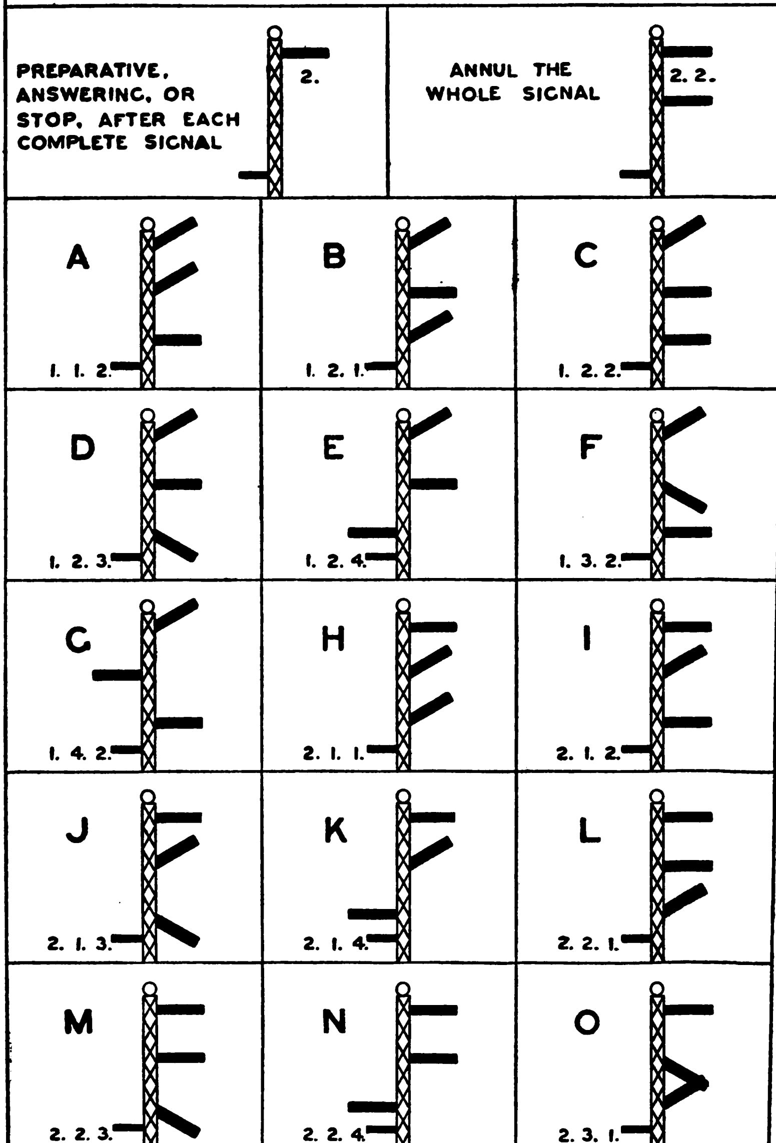
In the following pages are shown general alphabetical tables for making international code signals by means of the fixed semaphore, and signals by means of the British movable semaphore. Through the courtesy of Messrs. James Brown and Son, Glasgow, we are able to reproduce from "Brown's Signalling" tables showing the British method of semaphoring by hand flags. In the British method, the person intending to semaphore makes the international code signal V O X, "I am going to semaphore to you," and sets his semaphore at the alphabetical signal, with the indicator out, and waits until the ship to which the semaphore signal is to be made hoists her answering pennant "close up." Then he will proceed with the communication by spelling, making a momentary pause between each sign or letter; the arms are to be dropped between each word or group, the indicator only remaining out.

Should the answering pennant be dipped by the person taking in the signal, the last *two* words are to be repeated until the answering pennant is again hoisted "close up," which denotes that the person taking in the semaphore signal is ready to read and write down the signal. It is to be dipped when a word is lost, and the person making the signal is then to repeat the *two* last words until the answering pennant is hoisted again "close up."

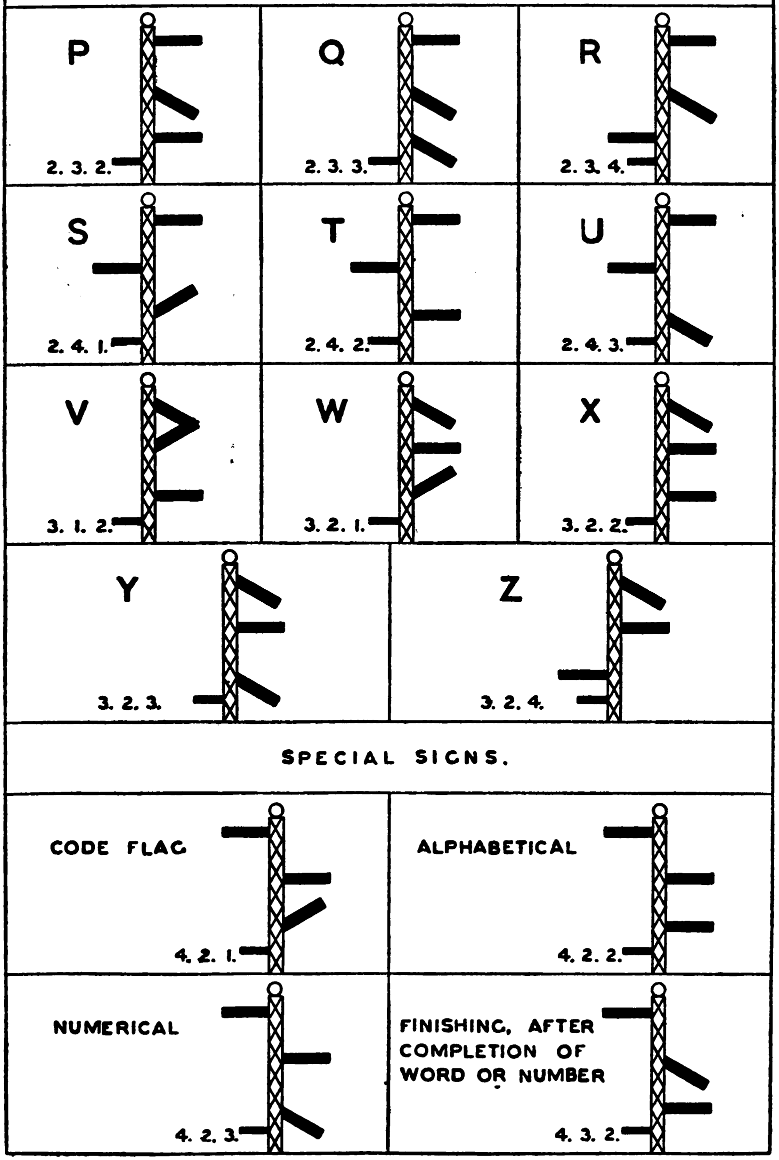
The British method of semaphoring by flags held in the hand which is shown is exactly the same as the British movable semaphore system, the positions of the apparatus which denote the letters, numbers, and special signs being identical in each case, the only difference being in the apparatus employed.

The French method of semaphoring by hand flags is based on the same principle as the British method, but the positions in which the flags are held to denote the letters, etc., are different.

GENERAL ALPHABETICAL TABLE FOR MAKING THE INTERNATIONAL CODE SIGNALS BY MEANS OF DISTANT SIGNALS BY FIXED SEMAPHORE.



GENERAL ALPHABETICAL TABLE FOR MAKING THE INTERNATIONAL CODE SIGNALS BY MEANS OF DISTANT SIGNALS BY FIXED SEMAPHORE.



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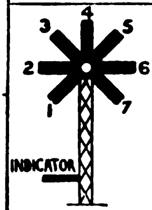		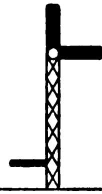	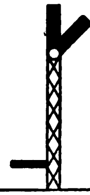	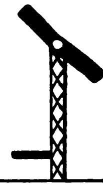
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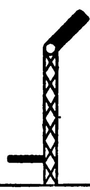
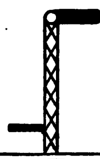
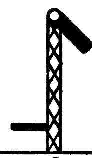
SIGN				
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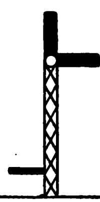
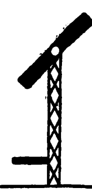
SIGN				
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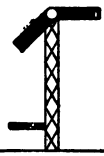
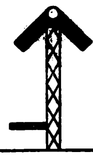
SIGN				
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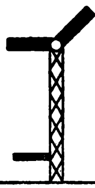
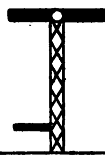
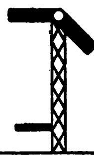
SIGN				
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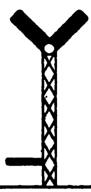
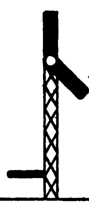
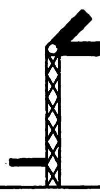
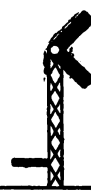
SIGN				
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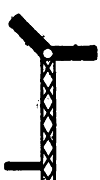
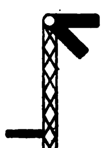
SIGN				
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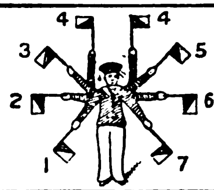

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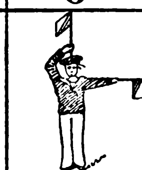
SIGN				
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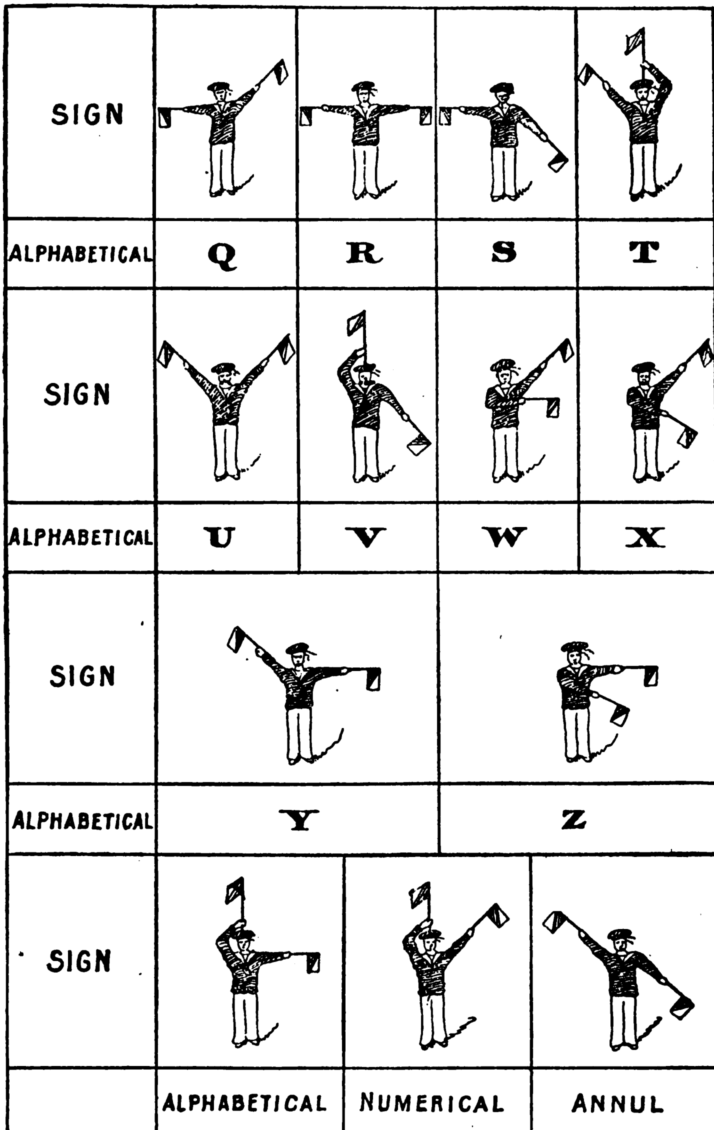

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WIRELESS TELEGRAPHY AND METEOROLOGY

"TO-DAY'S Weather," that little corner of his newspaper about which the reader waxes so cynical, is notably more accurate now than it was even a year ago. To wireless telegraphy must be given the credit of making weather prediction almost a certainty. Yet how little does the man who turns eagerly to the weather column realise what an important part wireless plays in meteorology!

Ere the advent of wireless the preparation of the forecasts and isobaric charts issued by the Meteorological Office as useful guides to the state of the weather was based largely upon telegraphic reports from various regions. The precise data obtained in this way was obtained only from a very limited area, and the Meteorological Department had to depend largely upon empirical data, with none too satisfactory results. Recognising the immense importance of a wireless weather service, the International Meteorological Committee which met in Paris in 1907 appointed a new Commission to deal with all questions connected with wireless in weather telegraphy, and referred to it the question as to the advisability of each member urging upon his Government "the importance of national regulations for such control of wireless telegraphy as will compel each ship licensed to carry wireless instruments to take and transmit to other ships or to stations on shore all observations received."

This question formed the basis of discussion at a meeting of the Commission held in London in 1909, which was presided over by Dr. W. N. Shaw, Director of the British Meteorological Department, and attended by Dr. Polis, Director of the Meteorological Observatory at Aachen, and Commander E. Simpson, Naval Attaché to the American Embassy in London. This Commission came to the conclusion that the transmission of reports by radiotelegraphy for meteorological purposes from ships must still be regarded as in the experimental stage, but that the work done by the German and the British Offices in inaugurating a system of wireless observations at sea had accomplished results that merited favourable consideration. The experiments were con-

tinued; the reports of daily observations at 7 a.m. and 6 p.m. have been transmitted by wireless telegraphy and placed on the working charts with the same confidence as those from land stations. The third Radiotelegraphic Convention, which met in London in the summer of 1912, provided for priority of weather telegrams which should not exceed twenty words in length.

An important proposal by Professor W. L. Moore, Chief of the United States Weather Bureau, for a universal ocean weather service by radiotelegraphy was read before the Commission for Weather Telegraphy, which was held at the Meteorological Office, London, last September, under the presidency of Dr. Shaw. Professor Moore's scheme, after suggestions as to legislation, observations and a uniform code, proposes to separate the North Atlantic Ocean into two zones, of which the 40th meridian west of Greenwich shall be the dividing line. Observations taken in the zone on the eastward of the 40th meridian would be forwarded to London and on the westward thereof to Washington, the London and Washington offices daily exchanging brief cables giving the location, intensity and probable direction of the movement of the more important highs and lows in their respective zones; further, forecasts for their respective zones would be made each day in London and Washington and transmitted to ships at sea. In the same manner the North Pacific Ocean would be divided at the 180th meridian, the exchanging offices being San Francisco and Tokio or Zi-Ka-Wei. For the Indian Ocean Calcutta is suggested as a centre; for the South Pacific a centre in Australia; and for the service in the South Atlantic centres at Buenos Aires and Cape Town.

The Commission reported to the International Meteorological Committee that it welcomed Professor Moore's proposal of an ocean weather service, being of opinion that such a service would be of great value to practical meteorology, but was of opinion that it was necessary for the representatives of the several countries to await information from their respective Governments as to the proposed legislation with regard to radiotelegraphy before offering an opinion as to the details of the scheme, and further that the organisation should make provision for the distribution to the various Meteorological Institutes of the meteorological information received by radiotelegraphy from the ocean in accordance with the conclusions of the London Radiotelegraphy Conference.

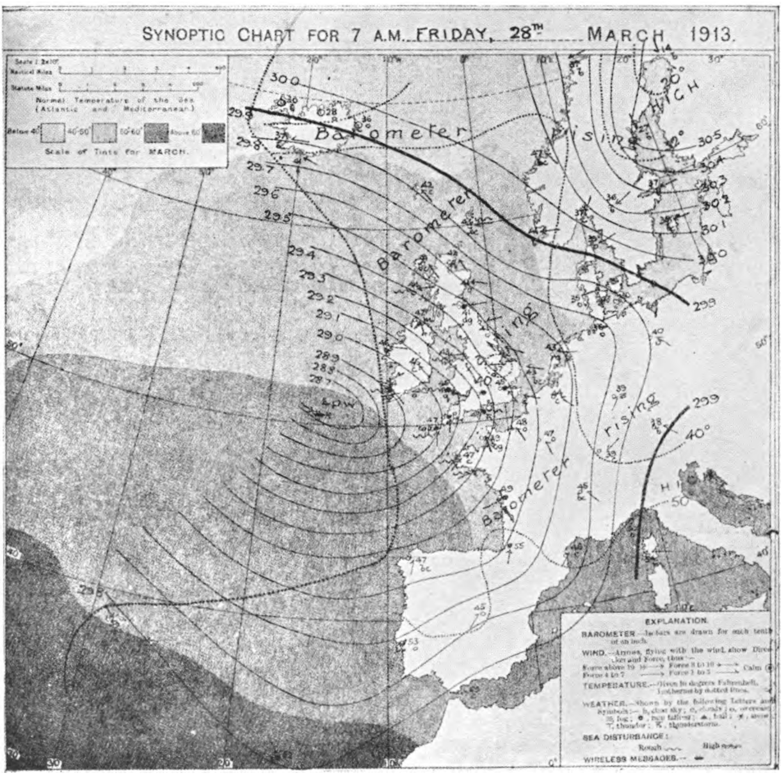
Until 1912 the area of the maps published in the weekly weather report was limited to Europe and Algeria, but such has been the progress in obtaining observations from the Atlantic by wireless that the area has since been extended westward so as to include the greater part of the Atlantic, from Iceland down to the Canary Islands, nearly the whole of Canada, and a large slice of the United States.

In the communication already referred to, Professor Moore states that since April 1st, 1912, the United States Weather Bureau has received regularly, by radiotelegraphy, reports of twice-daily observations made on board a number of vessels plying between the United States and ports on the Caribbean and the Gulf of Mexico. The service, which was organised primarily with a view to obtaining prompt information of West Indian hurricanes, has proved efficient. Besides a service of observations, arrangements have been made to enable the Bureau to communicate storm warnings to vessels in the regions referred to—a service similar to that which has been in successful operation since May, 1910, under the direction of the Central Meteorological Observatory in Tokio.

An extended weather service is contemplated in the Philippine Islands, which, lying right in the typhoon area as they do, should prove invaluable to shipping.

So far as Great Britain is concerned, arrangements are in force for the transmission of radiotelegraphic messages from ships in the Atlantic. The hours of observation are 7 a.m. and 6 p.m. The observations to be signalled are: (1) The reading of the barometer at a fixed hour to the hundredth of an inch; (2) the wind direction and force at the fixed hour; (3) the fixed hour and the state of the weather at the fixed hour; (4) the reading of the barometer, wind direction and force three hours before the fixed hour of observation. So long as the ship is between longitude 10° W. and longitude 30° W. a message should be sent regularly, (1) at 7h. 5m. a.m. G.M.T. reporting the observations at 7 a.m. G.M.T. with the control observations of 4 a.m.; and (2) at 6h. 5m. p.m. G.M.T. reporting observations at 6 p.m. G.M.T. with the control observations of 3 p.m.

The Marconi Company have arranged for the transmission from ship to ship of the messages sent when a ship is outside her own range from the shore station. If communication with shore has not been established within 48 hours of the time of observation, the



Meteorological Chart.

[To face page 556

messages will be forwarded by mail and not by telegraph. When the ship is between longitude 10° W. and 15° W. a message should be sent reporting observations at 1 p.m. with control observations at 10 a.m., if the position of the morning or evening observations be unfavourable on account of being beyond range of the shore station.

The Marconi Company also publish regularly a list of ships with which communication can be made by wireless telegraphy through the agency of the ordinary telegraphic service of the Post Office. For such a service the Post Office charge is at the rate of 6d. per word, with a minimum of 6s. 6d. per message. No such charge is made by the Governments of either the United States or Canada.

Though the application of wireless telegraphy to meteorology is still in its infancy, the results obtained from such a service are extremely interesting, as the following table indicates:—

WEATHER TELEGRAMS

Year ending March 31.	From H.M. Navy.	Received in time for Daily Weather Report of same day.	Received in time for inclusion in one or other maps in the report.	From Atlantic Liners.	Of Total Messages	
					In Time for "to-day's map" in D.W.R.	In Time for Yesterday's Maps in D.W.R.
1909*	121	—	—	1,219 (3 months)	67 (5 p.c.)	223 (18 p.c.) 42 p.c.
1910	112	—	—	4,388	8 p. c.	
1911	89	32	82	3,955	3·4 p. c.	39 p.c.
1912	68	16	61	4,922	232	2,352

* The experiment in transmission of reports by radiotelegraphy from British and German Atlantic liners was begun in January, 1909, in conjunction with the Deutsche Seewarte, and continued to the end of April. It was resumed as a joint experiment by the two offices during the months of August and September, with revised instructions and a more limited time and area for the transmission of messages. At the close of the second experimental period, the Deutsche Seewarte decided to discontinue the transmission of messages from German ships.

Through the courtesy of the Marconi Company, the shipping companies, and their officers, the messages were continued throughout the interval between the two experimental periods, and were later continued on the same terms by the co-operation of the Post Office and the Marconi Company, subject to reconsideration "should the meteorological traffic be found in future to interfere with the ordinary work of the coast stations."

Of the total messages received, the number that reached the Meteorological Office in London in time to be of direct and immediate application in the preparation of forecasts or the issue of storm warnings—that is, to be incorporated in "to-day's" map, which goes to press some four hours after the morning observations are taken at 7 a.m.—was, as the table shows, unfortunately, small. Nevertheless, even late messages have been of substantial

assistance to the forecaster, notably in connection with the issue of a "further outlook," which may indicate possible modifications of spells of settled weather or a notification of a probable spell of fine weather—information which could not be issued if wireless reports did not show the existence or non-existence of serious disturbances over the Atlantic when the observations were taken.

The accompanying map (of recent date) indicates clearly the value of wireless messages to the meteorologist. On Friday, March 28th last, for instance, the information contained on the map would have been speculative to the left (roughly) of the dotted line XY, but the receipt of a message from a vessel off the south-west of Ireland discovered "a very extensive cyclonic system, the centre of which, with pressure below 28·7 in., lies about 200 miles westward of the Kerry coast." This, taken in conjunction with the notes of "yesterday's weather," which stated that "near the Irish coast ships experienced strong south-easterly winds and cloudy weather, further west, as far as the 27th meridian, fresh to strong westerly and north-westerly winds and variable weather, snow at times"; formed a piece of information of excellent value. On Sunday, March 23rd last, "yesterday's weather" notes stated that "wireless reports show that as far west as the 23rd meridian ships experienced fresh to strong wind from the north-westward, with fair weather"; and this, with messages from a number of vessels in the Atlantic, enabled a very complete chart of precise information to be constructed.

As the Year Book goes to press an important conference on the subject of wireless telegraphy in meteorology is taking place in Rome, the results of which, in conjunction with the report (to be published later in the year) of the Royal Meteorological Society for the year ending March 31st, 1913, will, it may be anticipated, emphasise the valuable aid of radiotelegraphy in the determination and recording of the weather.

THE PROGRESS OF OCEAN JOURNALISM.

ALMOST unobserved, save by those who go down to the sea in ships, a new Fleet Street has arisen—a Fleet Street of the seas. It is fourteen years since the isolation of the ocean was first broken by the publication of the world's news on board ships. In that period a notable group of newspapers that ought to be, and are not, embodied in any Press Directory, though professing to be complete, has been born and flourishes on the floating cities. Their rise has been coincident with the improvements that have led to the wider adoption of wireless telegraphy. That they have flourished kills for ever the notion that man is glad to escape from the thrall of newspapers; they are as salt to his existence.

The first wireless newspaper was the *Trans-Atlantic Times,* the initial number of which was published on November 15th, 1899, aboard the American liner *St. Paul,* on a voyage from New York to Southampton. A four-page leaflet, it was sold for the benefit of the Seamen's Fund at a dollar a copy. It owed its origin to Mr. Marconi, who, with two of his engineers, was returning after the conclusion of some highly successful demonstrations in America, one of which, then a remarkable feat, was the "wireless" reporting of the races for the America Cup for the Associated Press. The news for the new venture was gathered from the Marconi station at the Needles, which the *St. Paul* was then approaching at 20 knots per hour.

Two items in this experimental journal have some historic interest:—

3.30.—40 miles. Ladysmith, Kimberley, and Mafeking holding out well. No big battle. 15,000 men recently landed.

3.40.—At Ladysmith no more killed. Bombardment at Kimberley effected the destruction of ONE TIN POT. It was auctioned for £200. It is felt that the period of anxiety and strain is over, and that our turn has come.

From a novelty the ocean journal of such modest beginning rapidly became a necessity. With the erection of high-power stations at Poldhu and Cape Cod, which made possible the constant reception of news from land, a daily issue became possible. The idea was rapidly adopted on vessels on the North Atlantic route. The Cunard Line commenced to publish the *Daily Bulletin* in a new and considerably improved form. On the vessels of the Holland-America Line the *Atlantic Daily News* was established; the vessels of the Compagnie Générale Transatlantique carried the *Journal de l'Atlantique;* and those of the Hamburg-America Line *Das Atlantische Tageblatt.* Passengers to South America were still uncatered for, but this was rapidly remedied by the Koninklijke Hollandsche Lloyd and the Compagnie Générale Transatlantique, on whose vessels was started a journal entitled the *Diario del Atlantico,* and the *Atlantic Daily News* circulated an edition on vessels of the Scandinavian-American Line running between Copenhagen and New York, and the publication of the *Journal de l'Atlantique* was extended to the vessels of the Compagnie Belge Maritime du Congo on the Antwerp-Congo route. Finally, the *South Atlantic Gazette* was introduced on five of the liners of the Royal Mail Steam Packet Company plying to Brazil and the Argentine. Several other shipping companies now publish a daily newspaper on one or more of their vessels; one of the most interesting of them is the *Wireless Herald,* which circulates on board the Alaskan Steamship Company's steamer *Northwestern.*

With the increased facilities offered by wireless, the ocean journals have increased in size. Profusely illustrated, the ocean journal of to-day has a wrapper and "inserts" in colours. It contains articles of literary, artistic, or scientific interest, and the latest social and musical gossip from London, Berlin, Paris, and the Riviera.

The centre pages are reserved for the wireless news. This consists of a *résumé* of the leading articles of the great English, French, and German dailies, political and general news, racing and other sporting results, the prices for a dozen of the most active shares on 'Change, and the movements of Liverpool cotton. A mass of advertisements of the most famous firms in the world, the menu of the day's dinner, and the previous day's run, complete the issue.

The Press news for vessels in the Atlantic is despatched every night from the high-power Marconi stations at Poldhu in Cornwall and at Cape Cod, on the American coast. Each night the operator in charge of the station shuts himself in the little sound-proof room, provides himself with pad and pencil, adjusts the pair of telephone receivers to his head, and awaits the stroke of midnight. Exactly on the minute, the faintest little whisper is heard in the telephones. The giant spark at Poldhu or Cape Cod is saying, "Good evening, ships; good evening, ships." These signals, though somewhat faint, are quite distinct. Quite recently it has been discovered that the human ear is more sensitive to a higher musical note than that which was produced by the spark formerly in use, which was at the rate of four thousand sparks per minute. The new musical spark has a frequency of thirty-six thousand impulses per minute, and is readable at considerably greater distances with the same power. In the meanwhile, with receivers tightly pressed against his ears, the operator is rapidly writing down pages of news. This continues for about an hour, at the end of which time the despatch is complete. The copy is then quickly transcribed on the typewriter and hurried down to the "editor on board."

When the copy is ready it is turned over to the typesetter, who prepares the type in the good old way in vogue in newspaper offices before the advent of the linotype machine. By long practice he has become very deft, and in a short time all is complete and passed over to the printer for his part of the work. The formes are rapidly adjusted to the motor-driven press.

The ocean newspaper is a marvel of sub-editing. The purser, on whom the task usually falls, shows himself the ideal of a sub-editor—the man who can get the story of the Creation into half a column. The news, tremendously important though it may be, is there in six lines or less, and there is no "fluff," no comment—for they do not write leading articles at sea yet.

"WIRELESS"

By The Man-in-the-Street

NOTHING has been more astonishing than the way in which wireless telegraphy has during the past two years demonstrated its claim to, and established itself in, popular favour. The populace, as a rule, is slow of comprehension; it is only to be compelled to serious notice by the strongly dramatic.

It has been emphatically so in the case of wireless telegraphy. When, in the early days of wireless, Mr. Marconi succeeded in sending signals over four miles on Salisbury Plain, the man-in-the-street (if this describes the casual reader of newspapers) was rather sceptical; certainly he regarded the matter only as a scientific novelty. When later he read that signals had been sent successfully between Poldhu and Newfoundland he began to admit rather reluctantly that there might be "something in it." But only when a ship in distress or the dramatic hunt for a criminal stirred his pulses did he capitulate to "wireless," and acknowledge without stint its immense value. It needed only the awful shock of a great maritime disaster forever to sweep away the last shreds of scepticism.

To-day he sees no wonder, no impossibility in an airship carrying a wireless apparatus. He would be surprised indeed if it did not. The earth girdled in forty minutes he looks upon with superior knowledge as a very poor attempt of imagination on the part of Shakespeare!

The part played by wireless telegraphy in these dramas has forcibly convinced the public that Mr. Marconi's genius has indeed swept away all barriers of space—that, to use an Americanism, wireless has "made good."

Maritime wireless telegraphy, however, has played such a leading part that the casual critic, it would seem, has somewhat failed to grasp its utility in other fields than ocean liners, warships, and coast stations. He would, perhaps, be astonished if he were told that wireless stations now dot the earth from Pole to Pole and from West to East, and that they are springing up in every place of commercial or strategical importance throughout the world.

An element of mystery, it must be confessed, still surrounds "wireless" for the bulk of the public. The observer views the

maze of wires over the Admiralty or the two frail poles above Marconi House with something of awed curiosity. As he gazes upward a message may be floating forth to the far ends of the earth. But the air gives no sign; the aerials keep their secret, silent save for the hum of their wires in the breeze.

The onlooker finds himself somewhat in the position of the primitive savage who beholds a conjuring trick the result of which is patent to him, but is ignorant of the means by which the marvel is produced. He is left with an impression, hard to eradicate, that messages are sent broadcast only to be rescued from space by some providential piece of luck; that somewhere receiving instruments are endeavouring, with the uncertainty of a fisherman endeavouring to drop a fly before a trout, to trap a message that is flying at large through the air. He has vague notions about "tapping," and this, in his mind, is *the* objection to be raised against all wireless telegraphy. This is because he has not a grasp of the mechanism which ensures that a message flashed over a vast distance shall be captured without the slightest inaccuracy only by the station for which it is intended; and, moreover, because he is forgetful that it is imperative, if maritime wireless telegraphy is to be of value, that every vessel shall be available for communication in cases of distress or emergency.

In brief: the man-in-the-street, though he sees its worldwide utility almost daily demonstrated, has hardly realised to what a high pitch of scientific and commercial perfection wireless telegraphy has been brought. His eyes would be opened if he could probe into the mysteries of the operating room and study the practical working of a wireless telegraph station. It is welcome news, therefore, that the man-in-the-street is to have much that puzzles him explained in simple language in a series of special articles in *The Wireless World*. He will end by becoming familiar with a revolutionary invention, but time and familiarity will never dim the marvel that has made the air to speak.

"THE WIRELESS MAP OF THE WORLD."

THE latest and surely one of the most striking maps now on the market is the " Wireless Map of the World." This map forms a feature of the YEAR BOOK, and in drawing attention to it here we would like to remind readers that they are able to obtain copies in various forms from 2s. 6d. net either direct from Messrs. George Philip & Son, Ltd., 32, Fleet Street, London, E.C., or from the publishers of this YEAR BOOK.

Within the past few years the development of wireless telegraphy has been so rapid that shipowners, merchants, and travellers, who have a special interest in being able to get into rapid communication with any quarter of the globe, have been faced with a great difficulty of keeping track of the new wireless stations which are springing up wherever civilisation is, and in some spots where it has hardly set foot. Thus the map of wireless stations has become indispensable.

Compiled by Marconi's Wireless Telegraph Co., Ltd., this newest of maps has been prepared and published by Messrs. George Philip & Son, Ltd., whose work in this direction is unrivalled. In a striking three-coloured sheet the map shows clearly the position of all stations open for ship-and-shore communication, high-power public and private stations, and other stations for trans-oceanic communication. Naval, lighthouse, lightship and private experimental stations are not shown.

All the highly specialised art and experience of Messrs. Philip & Son, as concentrated in the works of the London Geographical Institute at Willesden, were utilised in the creation of the map, and the result of their efforts can be gauged from the copy which is included as a supplement to this book.

In these days of foreign competition the progress of one branch of Messrs. Philip's work is interesting. The business of globe-making, which hitherto has been mostly done abroad, is in full swing in their factory, where, like giant puff-balls, the uncovered spheres are dotted about in sizes from one inch to nineteen inches in diameter.

WHY NOT LEARN TO *SPEAK* FRENCH OR GERMAN?

NOTE the emphasis on speak. Many people nowadays are content with picking up just enough of a foreign language to enable them to read, for example, jokes printed in French in "Punch." The reason, however, is not difficult to define. Everybody wants to learn one or more foreign languages, and most people are unable to attend classes (and even classes have limitations). But there is a *correspondence* system which enables one to acquire the ability to *speak* and to read.

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An interesting Booklet on the subject is sent on application to the International Correspondence Schools, Ltd., 130b International Buildings, Kingsway, W.C. The Booklet deals with German, French, Spanish, Italian, and also contains the history of the wonderfully successful International Correspondence Schools. This is the institution which has brought correspondence training to an advanced point of efficiency and success the I.C.S. Courses including all branches of Electrical, Motor and Steam Engineering Business Training, Architecture, Art, Poultry Farming, and many other occupations.

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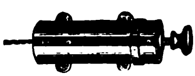

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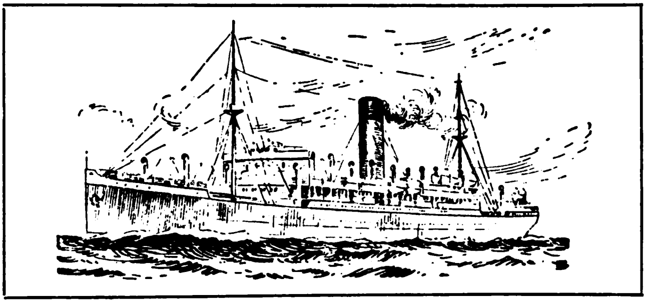

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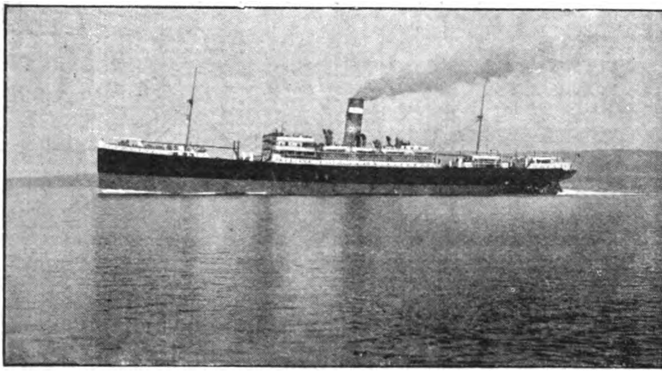

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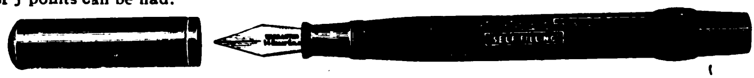

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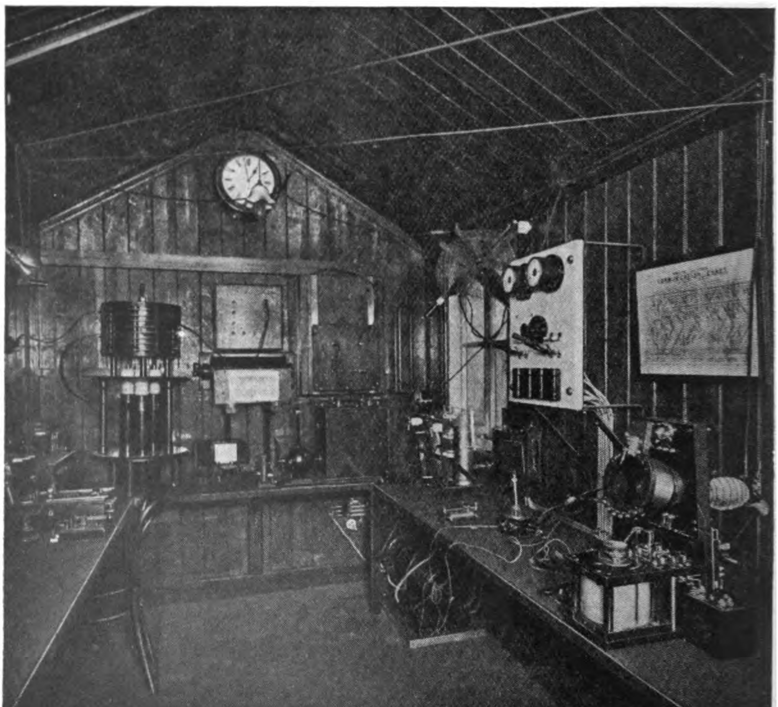

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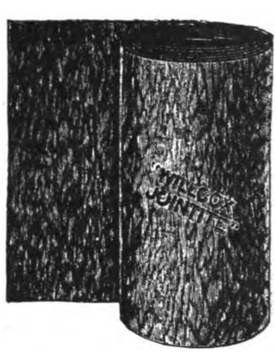

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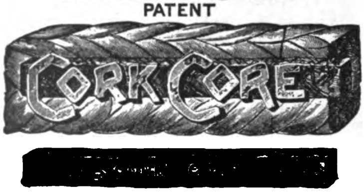

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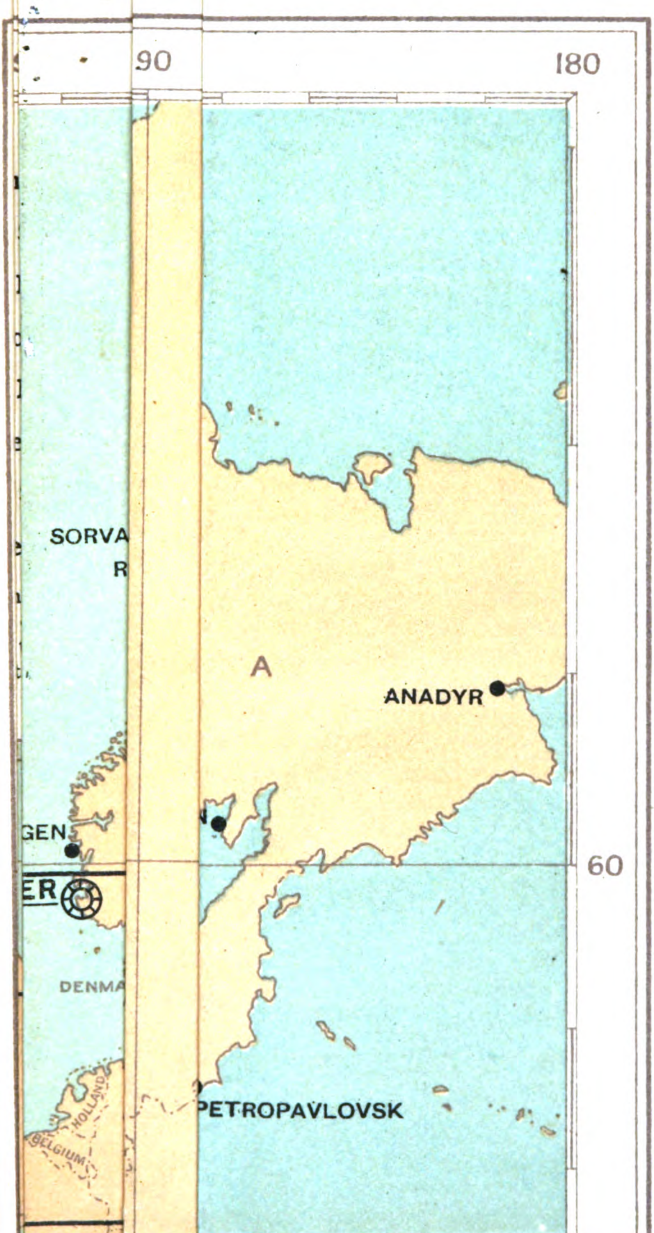
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